RESPONSE OF WILLIAM E. WHITAKER

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HYDROGEOLOGIC INVESTIGATION
WESTLAKE LANDFILL
PRIMARY PHASE REPORT

October, 1986
Project No. 84-075-4-004

Burns & McDonnell
Engineers-Architects-Consultants
Kansas City, Missouri

WEW 0003

Exhibit 14-B

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INTRODUCTION

SITE LOCATION

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The site of the West Lake Landfill is located at 13500 St. Charles Rock Road in Bridgeton, Missouri (see Figure IN-1). ?? The site of the old landfill ~~in area~~, ?? approximately _____ acres, was placed on the alluvium of the Missouri River, and part was placed in previously existing rock quarry pits at the edge of the Missouri River Valley. Current landfilling is being carried out in a deep quarry placed in bedrock formations which are hydrologically isolated from the old landfill, and is therefore not part of this study.

PURPOSE

The hydrogeologic investigation was intended to obtain the data necessary to define the groundwater flow patterns and flow rates in the vicinity of the site, and determine the nature and distribution of any contaminants which may occur in the groundwater. It was also intended to provide a basis for planning a program of long-term groundwater quality monitoring at the site and background data for development of a remedial action program if conditions warrant.

Because the geologic setting and stratification of the subsurface materials beneath the site influence the groundwater occurrence and flow pattern, a major part of the investigation was directed towards defining the site geology and engineering properties of the subsurface materials. In addition, a certain amount of data was available from previous investigations, and an analysis was made of the usefulness of that information.

SCOPE

To analyze the hydrogeologic conditions at the site, field work was performed in two phases, after evaluating existing subsurface information, as well as available geological publications. Soil samples were obtained from 15 borings drilled for this investigation. Selected samples were tested for soil engineering properties, including moisture content, density, grain size, and for fine grained soils, Atterberg limits. Piezometer standpipes were installed in the borings, both to future water level measurements and in some cases to obtain groundwater samples for chemical analysis. Twenty of the previously existing piezometers on the site were found to be usable for water level determinations. Therefore, water levels were measured periodically in a total of 35 piezometers. The piezometer tubes are screened at various depths in the alluvial aquifer, to determine the hydraulic head and groundwater flow direction at different levels in different and areas of the site.

Groundwater samples were collected from 18 selected monitoring wells. The wells were selected to provide data at widespread locations on the site and at different depths within the alluvium. Two rounds of sampling were performed, one in winter and one in summer. The water samples were chemically analyzed in the laboratory for full priority pollutants.

To assist in interpretation of the data from this investigation, maps and subsurface profiles have been prepared showing the hydraulic head in the aquifer, and the distribution of chemical constituents in the groundwater. The maps and profiles are included in this report.

The analysis of the data includes an assessment of the impacts of the landfill on the groundwater of the area. The analysis was applied towards recommending a plan for future, long-term groundwater monitoring.

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PART I

GEOLOGICAL SETTING

In the St. Louis vicinity, the bedrock stratigraphic sequence consists primarily of limestone and dolomite which were deposited, for the most part, in shallow epicontinental seas. Geologic deposits range in age from Precambrian to Holocene. The Precambrian rocks are the only units that do not crop out in the St. Louis area; they are, however, present in the subsurface. Many periods of emergence, nondeposition or erosion are implied by the disconformities and local unconformities observed in surface exposures and well data.

Bedrock in the West Lake area consists of limestones of the Pennsylvanian and Mississippian systems (Ref. 1). A thin deposit of the Cherokee Group (Pennsylvanian) occurs nearest the surface at the site. The Cherokee consists primarily of limestone in this area, but may also contain interbeds of other clastic sedimentary rocks, primarily shales (Ref. 2). Below the Cherokee are Mississippian limestones of the Meramecian series. The Ste. Genevieve limestone (approximately 30 feet thick), if present here, is apparently quite thin. Occurring stratigraphically below the Ste. Genevieve is the St. Louis Formation (approximately 100 feet thick). The Saint Louis is the primary limestone which is presently mined at the West Lake Quarry. Below the St. Louis Formation is the Salem Formation (approximately 100 to 160 feet thick), a limestone which is also being quarried at West Lake. The Warsaw Formation occurs below the Salem. The Warsaw is a shaley limestone with some shale interbeds (approximately 80 feet thick) and quarrying probably terminates near the top of this stratum.

The present structural attitude of the rock units is the result of compressional, tensional and uplifting forces which moved and altered the units from their original depositional positions. These forces have folded, fractured, faulted and tilted the rocks in the St. Louis area to a moderate degree, and the resulting structures are superimposed on a regional dip or large-scale tilting of the rock units of from 60 to 80 feet per mile to the northeast. Locally, in the West Lake area, the bedrock strata are nearly horizontal with minimal fractures.

Alluvium, including thick deposits of glacial outwash and some river terrace deposits fills the deeply eroded bedrock channel formed by the Missouri River during the Pleistocene Epoch. The thickness of the alluvium is variable because of irregularities in the bedrock surface upon which it was deposited, but the maximum known thickness is approximately 150 feet. The alluvium is composed of clay, silt, sand and gravel. In general, the alluvium becomes coarser-grained with depth. Occuring on the Missouri River valley bluffs above the river valley are thick loess deposits. These loess deposits directly overlie the bedrock of the uplands.

The West Lake Landfill site is located on the Missouri River valley's east wall (Figure I-1). Bedrock in the landfill vicinity occurs near the surface at the point of transition between the loessial bluffs to the east and the alluvial valley to the west. The generalized line of transition is shown on Figure I-2. The bedrock surface drops off sharply below the valley to the west and the loess bluffs rise abruptly above the bedrock to the east. The quarry operations occur generally where the bedrock is nearest the surface at the edge of the valley wall, and past landfill operations have generally extended from the quarry area westward on the alluvium. The surface of the alluvial deposits is quite level, although small drainageways and channels create slight depressions and terraces.

Figure I-1 is a generalized, vertically exaggerated geologic profile across the Missouri River valley in the vicinity of the site. This profile illustrates the relationships between the impervious bedrock, the alluvial aquifer, and the general range of water table elevations in the aquifer.

Figure I-2 is a site plan showing the topography of the site and the locations of the borings drilled and/or used in this investigation. Also shown on Figure I-2 are the approximate boundaries of the landfilled area.

Figure I-3 is a detailed geologic profile along the southwest perimeter of the existing landfill. The location of the line of the detailed geologic profile is shown on Figure I-2. Figure I-3 shows the relationships between the bedrock and the overlying alluvium, comprised of the coarse-grained aquifer and the uppermost, generally fine-grained aquitard. Also shown are water levels in piezometers at times of relatively high river stage (and consequent high water table in May 1984) and relatively low river stage (and consequent low water table in February 1984). Also, note that the water table intersects the ground surface in the drainage ditch adjacent to the road at the northern end of the profile line.

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PART II

SUBSURFACE INVESTIGATION

A. PRELIMINARY AND PRIMARY INVESTIGATIONS AND PREVIOUS STUDIES

A preliminary subsurface field investigation of the site was conducted in August, 1984. The field and laboratory work performed for this investigation were intended to supplement information from previous investigations of this site, and to obtain additional information on groundwater conditions. The preliminary investigation included drilling and sampling nine borings, four of which extended to bedrock. The locations of the borings (which are numbered in the 80's) are shown on Figure I-2. The information was presented in the report entitled "Hydrogeologic Investigation - West Lake Landfill - Preliminary Phase Report", January, 1985 by Burns & McDonnell. After the preliminary phase of the project was completed and the data evaluated the primary phase was begun. Six test borings were drilled and piezometers installed in April and August, 1985. All six test borings were drilled to bedrock. The locations of these borings (numbered in the 90's) are shown on Figure I-2.

Existing piezometeres (numbered in the 50's, 60's, and 70's) were evaluated for soundness of construction by field inspection and response to water level changes and found to be acceptable for indication of water levels (hydraulic head). Therefore, data collected from these piezometers was utilized to evaluate groundwater gradients and flow directions.

Piezometers were installed in all borings for both phases for purposes of water level determination were used for obtaining water samples for chemical analysis. Some of the piezometers were clustered with existing monitoring wells or with each other resulting in eight clusters of water level monitoring points that can be used to detect possible differences in water pressure (hydraulic head) with depth. Boring depths ranged from 22.0 feet to 143.3 feet. Soil samples were obtained on 5- or 10-foot centers in all borings according to ASTM standards. Using thin-walled Shelby tubes, 12 undisturbed soil samples were obtained at various depths in the borings. Using standard penetration test procedure, 156 split-spoon samples were also obtained.

The geologic logs of all of the borings drilled for this investigation are included in Appendix A.

B. MONITORING WELL PROGRAM

Piezometers were installed in each boring according to the typical construction diagram in Appendix B. Specific construction details for piezometers are noted on the respective boring logs. When piezometers were not responding to changing water levels in the aquifer they were developed by evacuating with compressed air until clear water flowed freely into the piezometer. Piezometer D-87 did not respond even after evacuation by compressed air, so it was bailed and surged to ensure that it was functioning properly. Piezometers were installed at shallow depths (designated "S" and screened near the water table elevation), deep depths (designated "D" and screened near the bedrock surface), or intermediate depths (designated "I"). Depths were determined considering depths of nearby existing piezometers so that the entire saturated thickness of the aquifer could be monitored. Because the depths of many of the shallow and intermediate piezometers were close to each other, data from the shallow and intermediate piezometers were all used together for contouring the water table.

Presence and depth of free water was noted on boring logs during drilling, when possible, and water levels in borings and piezometers were noted immediately after installation and at various times thereafter. These water levels, along with water levels from existing monitoring wells, are tabulated in Appendix C of this report. A surface water monitoring point (SMP-4) was placed in the drainage ditch along St. Charles Rock Road at the northern tip of the site. Throughout most of the year, the water table in the aquifer is above the bottom of the ditch, so monitoring surface water elevations there provides data on hydraulic head in the aquifer. SMP-4 was destroyed before its location and elevation were surveyed but changes in water levels were recorded for three months.

During the preliminary phase, in-situ hydraulic conductivity was determined in four piezometers using a single-pulse bailer test, performed according to methods described by Hvorslev (1951). An air compressor was used to evacuate the piezometers, and water levels were measured as the well recovered. Data from these tests along with calculations of permeability using Hazen's formula are presented in Table D-1 in Appendix D of this report.

C. DRILLING AND SOIL TESTING

The soil borings were drilled using a truck-mounted Acker MP-5 drill rig. Generally, 4-inch-diameter continuous-flight augers were used to drill above the water table and 4-1/2-inch-diameter Tri-cone rotary wash methods were used below the water table. The drilling was performed by Wabash Drilling Company (Subsurface Construction Company), St. Louis, Missouri, under the continuous observation of a Burns & McDonnell geologist who logged the encountered soil and rock materials. Surveying to determine boring elevations was done by Bollinger Surveying Company.

Laboratory testing of the soils material was performed by Kansas City Testing Laboratory, Shawnee Mission, Kansas. Tests included (three) moisture contents, (three) dry unit weights, (two) Atterberg limits, (eight) sieve analyses, and (two) hydrometer analyses. All tests were performed in accordance with ASTM standards.

The results of all soils laboratory tests for engineering properties are included in Appendix D.

D. GROUNDWATER SAMPLING AND CHEMICAL ANALYSIS

1. SAMPLE LOCATIONS

For the evaluation of groundwater chemical quality, 18 existing monitoring wells were selected for sampling. The wells were located in various locations around the site of the previously landfilled areas and screened in the shallow, intermediate and deep parts of the alluvium. There were two sampling rounds, from December 11 to December 15, 1985, and from May 19 to May 21, 1986. The purpose was to evaluate the difference in groundwater quality in relation to seasonal variation. The sampled monitoring wells were as follows:

S-51	D-87
I-59	D-88
I-66	D-89
S-80	D-90
D-81	D-91
D-82	D-92
D-83	D-93
S-84	D-94
D-85	D-95

It should be noted that Piezometer I-66 was not sampled during the first sampling round because it was inundated by surface water in the road-side ditch.

2. FIELD METHODS

All samples were collected by a Burns & McDonnell Environmental Engineer with assistance from West Lake employees.

Before sample collection, the water level was measured to determine the amount of water in the piezometer casing. Approximately three casing volumes were then removed from each piezometer with a bailer and the piezometer was allowed to recharge before sampling. A Teflon bailer with polypropylene rope was used to flush and sample.

Before moving to the next well, the bailer was thoroughly cleaned with distilled water and the polypropylene rope was replaced.

The samples were collected in bottles prepared and supplied by the laboratory. The volatile samples were collected first, leaving no air space in the sample vials. All preservatives were added to the samples in the field except for the metals samples. Preservative was added to the metals samples after they were filtered through a 45-micron Geotech backflush filter. This took place at the end of each sampling day.

All samples were kept cool until delivery to the laboratory. All sample bottles were accompanied by Chain-of-Custody forms listing information such as the sample number name of sampler, date, bottles, and type of analysis.

3. CHEMICAL ANALYSIS

All samples were analyzed for priority pollutants listed under 40 CFR, Part 122. The priority pollutants consist of the following:

- Volatile Organics
- Acid/Base Neutral Extractables
- Pesticides/PCB's
- Total Phenols
- Total Cyanide
- Metals

In addition, during Round 1, samples for Monitoring Wells D-83, S-84, D-85 and D-92 were analyzed for gross alpha and beta radiation. On May 7 and 8, 1986, water samples were collected from 32 wells by Department of Energy personnel and analyzed for gross alpha and beta radiation.

4. LABORATORIES

The priority pollutant samples collected during Round 1 were analyzed by Environmental Trace Substances Research Center, located in Columbia, Missouri. The samples analyzed for gross alpha and beta were sent to Controls for Environmental Pollution, Inc., in Santa Fe, New Mexico. Volatile organics were analyzed according to EPA Method 624. Base-Neutral Extractables were analyzed according to EPA Method 625. Acid extractables were analyzed according to EPA Method 604. Pesticides and PCB's were analyzed according to ERA Method 608. Metals were analyzed by inductively coupled plasma, and cold vapor atomic absorption was used to detect mercury.

The second round of priority pollutant samples was analyzed by Envirodyne Engineers of St. Louis, Missouri. The Department of Energy gross alpha and beta samples were analyzed by Oak Ridge Associated Universities, in Oak Ridge, Tennessee. Volatile organics were analyzed by EPA Method 624. Base-Neutral/Acid Extractables, and Pesticides/PCB's were analyzed by EPA Method 625. Arsenic, selenium, silver, antimony and thallium were analyzed by furnace atomic absorption. Mercury was analyzed by cold vapor atomic absorption. The remainder of the metals were analyzed by inductively copyled plasma.

E. DATA INTERPRETATION

1. GEOLOGICAL INFORMATION

The geological and subsurface information obtained from the test borings on the site is illustrated on several subsurface profiles to facilitate interpretation and understanding of the geology of the site. The profiles have been used to show the lateral changes in subsurface materials, determined from the geologist's logs and soils laboratory data.

2. WATER LEVEL DATA

Selected rounds of water level measurements have been contoured in plan view to illustrate the configuration of the water table in different parts of the site at times of different river stage. From the water level contour maps, directions of groundwater flow are indicated. Maps were prepared separately for the deep piezometers so that comparison between groundwater flow in the deep and shallow/intermediate zones in the aquifer could be made. Note that the depths of the bottoms of the piezometers designated shallow and intermediate are vary nearly the same, so for purposes of this report, they are contoured together. Selected water levels are also shown on geologic profiles (Figures I-1 and I-3) to illustrate the relationship between deep and shallow water levels. In addition, two graphs are provided showing change in Missouri River stage relative to changes in water levels in selected piezometer.

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PART III

SUBSURFACE CONDITIONS

A. UNCONSOLIDATED OVERBURDEN

There are basically two types of unconsolidated overburden in the West Lake vicinity; windblown silt (loess) and Missouri River alluvium. The loess overlies bedrock on the bluffs bordering the Missouri River Valley. The old landfill operations on the West Lake property are generally to the west of the loess bluffs. No loess was encountered in test holes drilled for this investigation. Due to the long-term construction activities at the site, soil and crushed rock fill material occurs to depths of over 30 feet in some places on the site. An example can be seen on the log of Boring D-92, where fill soil and rock occurs to a depth of 31.0 feet.

Within the Missouri River Valley are thick deposits of alluvium. The alluvium consists generally of sand and gravel, with minor seams and lenses of clay and silt. Silt and clay occurs in the alluvium in significant amounts at shallow depths, with the maximum depth of occurrence of approximately 25 feet in some locations, and as little as approximately 5 feet in other areas. The alluvium extends to depths of over 100 feet. The alluvium thins abruptly toward the valley edge as the bedrock rises beneath it to form the valley wall. Permeability of the alluvium ranges from 2.4×10^{-4} cm/sec to 2.5×10^{-1} cm/sec (see Table D-1 in Appendix D).

Ten borings drilled for this investigation penetrated the full thickness of alluvium. Table III-1 presents a summary of alluvium thicknesses and the depth to bedrock in each of these borings. All ten of these borings terminated in limestone bedrock.

Table III-1

SUMMARY OF BORING DEPTHS

Boring No.	Thickness of Alluvium (ft(	Depth to Bedrock (ft)
D-83	115.3	115.3
D-85	61.5	83.5
D-87	92.0	111.0
D-89	33.9	47.8
D-90	46.0	46.0
D-91	44.0	44.0
D-92	112.6	143.6
D-93	104.0	118.0
D-94	108.8	108.8
D-95	92.6	100.6

Natural deposition in the Missouri River floodplain has occured as the river channel meandered between the valley walls creating point bars and natural levees, filling abandoned channels, and temporarily forming swamps, lakes, and small channel environments. This resulted in the deposition of various materials throughout the floodplain, and, consequently, lithologic units terminate in the subsurface very abruptly both horizontally and vertically. A relatively consistent pattern in the alluvial profile is that coarse sands and gravels tend to occur lower in the profile and silts and clays occur nearer the ground surface. Soils that are predominantly silt and clay tend to occur in the upper 5 to 10 feet of the natural alluvium, but fines occur to depths of approximately 25 feet in places. This is generally above an elevation of 430 feet. A few seams of fine-grained soil occur below the 430-foot elevation as in Boring D-81. South of the site, a substantial thickness of silty clay was encountered during the investigation. Boring D-91 encountered a deposit of silty clay to a maximum depth of 31.0 feet.

Between elevations of roughly 450 feet and 400 feet, the alluvium is characterized by interbedded seams of sand, silty and clayey sand, and a few silty clay seams. These seams range in thickness from a few inches to over 10 feet. They are quite discontinuous laterally as evidenced by the poor correlation between adjacent borings. This material is generally of a lower permeability than the underlying sands and may be considered an aquitard in the areas where the fines occur. Flow occurs through the soil, but transmission is impeded by the presence of a significant amount of fines. This zone is of a highly variable thickness due to its depositional history (see Figure I-3). In places, the bottom of the old landfill apparently extends below this fine grained stratum into the aquifer sands below.

Below an elevation of roughly 400 feet, thick deposits of sand which are quite uniform in character, are predominant. Several borings encountered gravel seams. For example, Borings D-81, D-92, D-93, and D-95 encountered gravel seams at depths ranging from 47 to 123 feet. While being more uniform in character than the overlying alluvium, these deeper sands exhibit changes in lithology and grain-size characteristics when correlated between borings.

B. BEDROCK

Bedrock was encountered in Borings D-83, D-85, D-87, D-89, D-90, D-91, D-92, D-93, D-94 and D-95. The rock was penetrated from 0.0-feet to 1.2 feet in these borings. The bedrock is described as a cream to light-brown limestone, medium strong to strong, and correlates with the St. Louis and Salem limestones observed in the West Lake quarry. The bedrock below the alluvium is apparently only slightly weathered as evidenced by the difficulty with which it was penetrated. A few fracture zones are visible in the quarry but the limestone is predominantly unfractured. Very few seeps discharge into the quarry which has been excavated to more than 180 feet below the alluvial water table.

Table III-2, below, lists the borings in which bedrock was encountered and the depths and elevations of the bedrock surface, which was found to be limestone in all cases.

Table III-2

Boring No.	Depth to Bedrock	Elevation of Bedrock
D-83	115.3	329.1
D-85	83.5	369.4
D-87	111.0	349.0
D-89	47.8	406.3
D-90	46.0	400.0
D-91	44.0	404.0
D-92	143.6	331.77
D-93	118.0	332.70
D-94	109.8	333.88
D-95	100.6	352.49

The base of the nearby quarry is in shaley limestone, probably of the Warsaw Formation, which is at an elevation of about 240 feet. The St. Louis and

Salem limestones in the quarry area extend from near the ground surface down to the Warsaw Formation.

C. GROUNDWATER OCCURRENCE

1. GENERAL DESCRIPTION

Groundwater in the alluvium generally occurs as a single aquifer under water table conditions. There are a few localized exceptions to this condition which cause minor and usually temporary confining conditions. Another minor exception that has been found is that the water level in piezometer S-80, at the south end of the site represents a perched water table above a localized silt and clay deposit. The water table surface is quite level, not varying more than a foot or two in elevation over most of the site at any given time; thus the gradient is very low.

The water table elevation fluctuates vertically as much as 7 feet, in any particular well, throughout the year in response to variations in precipitation. Precipitation affects the Missouri River stages, infiltration on the site, and some localized recharge due to runoff from the river valley bluffs; all of which have direct affect on the water table elevations.

Generally, the major portion of the aquifer is responding to a gradient induced by the configuration of the Missouri River bedrock channel and also influenced by the Missouri River stage (Ref. 3). but superimposed upon this general gradient are some minor groundwater mounds and depressions which influence the gradient near the water table surface. These are apparent from groundwater contour maps, several of which were constructed from water level data obtained from this study. The August 29-30, 1984 data are representative of the perennial contour pattern and are shown on Figure III-2. The most prominent of the water table features is the persistent mound occurring in the southern portion of the landfill.

The water table gradient is variable with time in different parts of the aquifer, although these variations are of a relatively minor scale. Since the water table is nearly level, a relatively minor change in the water level in an area can cause a change in flow direction at the water table surface. Because of the many minor effects on the water table over the area, such as local recharge and discharge areas and variable soils materials, the water table is an uneven surface at any given time and may change its configuration over a period of time. However, overall movement of groundwater over a substantial period of time is most often to the northwest, either toward the river or subparallel to the river.

The elevation of the water table at the site generally fluctuates between 430 and 440 feet during the year. The water table is high during and after the spring rains and snowmelt of March and April and rises slightly after the fall rains in October (see Figures III-2 and III-3). The water table fluctuations generally mimic the Missouri River stage fluctuations in a subdued manner.

At any given time, the water table is nearly level with the notable exception of the persistent groundwater mound in the vicinity of Piezometers S-75, S-76, I-73 and D-89 which is discussed later in this section. In the northern half of the landfill site, the relief on the water table surface is commonly less than 0.5-feet at any given time, indicating a very low gradient. The groundwater mound in the southern portion of the landfill is seen to exhibit relief of from 1 to about 4 feet at the different times of observation for this study.

At times, there is an apparent predominantly downward component of flow in the aquifer near the valley wall. This is indicated by the difference in hydrostatic head between piezometers screened in the upper and lower portions of the aquifer. The deeper piezometers generally indicate lower water levels than nearby shallower piezometers. Since groundwater flows from areas of higher pressure to lower pressure, the flow would be generally downward in this area. An example of this is seen when comparing October 1984 water levels in the deeper D-81 and D-89 piezometers to water levels in the shallower S-75 and S-76 piezometers. The calculated vertical gradient near the valley wall varies somewhat throughout the year but generally ranges between 0.117 and 0.0007. This vertical component of flow dominates the horizontal component near the valley wall, which generally ranges between 0.003 and 0.008 throughout the year. Further west, away from the sloping bedrock valley wall, flow is predominantly lateral. Comparison of deep hydrostatic head in D-83 with shallow hydrostatic head in I-62 indicates little elevation difference and, therefore, almost no vertical component

units?

of flow exists. The flow is basically horizontal; generally toward the Missouri River. The horizontal gradient generally ranges between 0.0003 and 0.0007 throughout this year as calculated from regional groundwater contours (obtained from Earth City piezometers as shown on Figure IN-1).

units?

Generally, the water table elevation is influenced most significantly by the stages of the Missouri River. As the river rises or declines, the water table responds similarly but in a delayed and subdued manner. Hydrographs were constructed from piezometers which exhibit the typical pattern of change in water levels throughout the year. As can be seen by comparing these hydrographs with the Missouri River stages (Figures III-2 and III-3), the water levels in the piezometers are seen to rise steadily in the spring, when the river is rising, and decline during the drier summer months. The rise in the water table at the West Lake site lags behind the overall rise in the river stage during the spring by several weeks. The alluvium creates a buffer zone between the river and the alluvial groundwater beneath the site causing the time lag. Another effect of the alluvium is to decrease the effect of rapid changes in the river stage so that the water levels in the piezometers do not fluctuate dramatically on a daily basis. This lack of daily fluctuation of the water table was documented by the continuous water level recorder, which reveals gradual, slow changes in water table elevation.

The water table generally slopes downstream and toward the river during the dry summer months and generally downstream during the wet spring

?? what are they trying to say here??

months, although changes in gradient direction apparently occur at other times during the year in response to changes in stage of the Missouri River. Determination of this overall gradient direction is based upon Earth City piezometer readings and from water table contour maps of the floodplain across the Missouri River Valley from the site (Ref. 4) (see Figure IN-1). The gradient may be away from the river for short periods of time during high river states, but this is apparently only a localized affect near the river.

unconfined ??

The unconfined condition of the aquifer is evidenced by the absence of a continuous aquiclude being correlated between borings. Another indication of unconfined conditions is the water level data from clustered piezometers. As can be seen by comparing Figures III-1 and III-4, five clusters (pairs) of piezometers, S-84 and D-85, I-66 and D-94; I-62 and D-83; S-82 and D-93; S-51 and D-90; and I-50 and D-91 show essentially no elevation difference in water levels between the piezometers screened in the deeper portion of the aquifer and the adjacent piezometers set to shallower depths. This indicates that the deep and shallow wells were screened in the same hydraulic unit and no confining conditions exist there. It also indicates horizontal flow in these areas with little or no vertical component of flow at the time these measurements were made.

Why & how did they determine horizontal flow??

Another cluster, S-80 and I-50, exhibits significant, though not large, water level differences between adjacent deep and shallow wells. The difference between water levels in S-80 and the deeper I-50 is due to a shallow perched water zone which is intercepted by the screened segment of Piezometer S-80. Piezometer S-80 indicates the head in the perched zone and I-50 indicates the head in a deeper sand seam. The sand seam is confined below silty clay. Because the water elevation in I-50 is very nearly the same elevation as in nearby wells and since the clay seams in the vicinity tend not to be laterally extensive, it is concluded that the groundwater in I-50 is semi-confined, rather than completely confined. That is, it has some degree of hydraulic connection with the surrounding groundwater, but is partially confined because of the presence of the overlying low-permeability material. Since the water table in Piezometer S-80 is perched, the water levels from this well are excluded from the groundwater contour maps.

Water levels were continuously monitored in Piezometer I-62 from May 24 to October 23, 1984 using a Stevens water level recorder. The water level remained fairly steady, with only minor fluctuations, until approximately July 6, 1984 when a fairly steady decline from 436.1 to 435.6 occurred until about the end of July. Another more rapid decline in the water level occurred from about August 6 to August 28 when the water elevation dropped from 435.4 to 432.9. The water level remained fairly steady through September until October 3 when the recorder was removed. The indication from the continuous monitoring data is that monthly water level measurements are adequate for detecting any significant changes in water table elevations.

FLOW DIRECTION AND GRADIENTS

Figure III-1 includes water table contours and arrows indicating general groundwater flow direction. It is important to note that the map was made using water level data from August 29 and 30, 1984, and that the pattern of contours is consistent with the pattern from the other water well measurements made for this study, thus, the pattern of water table contours is relatively constant throughout the year, even while the elevation of the water table in the entire aquifer is illustrated by the water levels shown on the detailed geologic profile across the site (Figure I-3).

To determine the difference between groundwater flow in the upper portion of the aquifer as compared to that in the lower part of the aquifer, a comparison was made between water levels measured in the shallow and intermediate piezometers and those measured in the deep peizometers.

The deep and shallow flow patterns are generally similar, but there are times when the hydraulic gradients in the lower part of the aquifer are extremely low (less than 1 foot per mile), and the groundwater flow rates in the deep aquifer are negligible. This can be seen by comparing Figure III-4 (where the flow patterns and gradients in the upper aquifer are similar to the general pattern shown on Figure III-3), with Figure III-5, where the gradient is negligible, but very slightly elevated in the northern parts of the landfill. Figures III-5 and III-6 have been provided to illustrate that there are times when a gradient builds up on the hydraulic head in the deep aquifer, in response to recharge from the surface water recharge zones in the southeast part of the site. The changing pattern of hydraulic head distribution in the deep portion of the aquifer is also probably related to changing pressures in the aquifer canal by rise and fall of the river stage. As can be seen in Figures III-6 and III-7, the pattern of groundwater flow in the deep aquifer is similar to that in the shallow aquifer.

The flow direction of groundwater beneath the West lake site is dependent upon which part of the aquifer is considered. At the surface of the water table, a perennial mound in the southern portion of the site controls the flow direction (see Figure III-1). Groundwater in the upper portion of the aquifer will flow away from the mound to the north, west, and south. Because this mound is small (less than 3 feet of relief in comparison to the thickness and volume of the aquifer, it has only a slight affect on groundwater flow direction at greater depths. The groundwater mound is the result of a local recharge area created by: (1) the pumping of water from the quarry to surface drainage ditches which is discharged to this area, (2) surface infiltration along Old St. Charges Rock Road, and (3) possible leakage from unlined surface water holding ponds in the quarry vicinity. Groundwater in the lower portion of the aquifer flows generally in a westerly or northwesterly direction in response to the gradient induced by the Missouri River stage and the gradient of the river valley. Flow is predominantly downward near the valley wall. Another influence on the flow direction is the nonuniform permeability characteristics of the aquifer. Because of the various alluvial materials, such as clay lenses and small sand-filled channels, groundwater will flow more rapidly through the higher permeability materials. These effects will tend to be localized and will not change the overall flow direction drastically.

In the northern part of the site where the water table gradients are seen to the very low (see Figure III-1), groundwater flow is generally northward near the northern end of the site and westward from the western portion of the landfill. Thus, flow is generally radiating from the central portion of the landfill toward the perimeter, probably due to slight mounding of the water table within the landfill itself. Because of the extremely low hydraulic gradients and low relief on the water table, this pattern may not be consistent with time; local variations may alter the pattern somewhat, but these variations are minor. Thus the pattern shown on Figure III-1 predominates throughout the year.

2. GROUNDWATER QUALITY

a. Distribution of Chemical Constituents

Rewrite

The lateral and vertical distribution of detected chemical constituents was investigated to determine if the landfill was affecting local and downgradient groundwater quality.

(1) Lateral Distribution: Chemical results were obtained from wells upgradient, downgradient, and around the perimeter of the

Reference

landfilled area. When chemicals were detected at several locations, the results were plotted on a site map. The most informative chemical distribution maps are shown in this report. The complete results of chemical analysis are contained in Appendix E.

The only priority pollutant volatile organic compound detected in both rounds was methylene chloride. The chemical distributions for Round 1 and Round 2 are shown on Figures ___ and ____. In Round 1, methylene chloride was detected in wells throughout the landfill area. Piezometer D-90 showed 83 ug/l of methylene chloride, the highest detected level. The concentration pattern was irregular and therefore not contoured. In general, the downgradient wells showed lower levels of methylene chloride (from 6 to 12 ug/l), except for Piezometer D-83, which had 55 ug/l. * Acetone, not a priority pollutant, was also detected in most samples. Methylene chloride was also detected in Round 2, but at only three locations and at lower concentrations. Piezometer D-90, only contained 6 ug/l. Piezometer D-89 showed 10 ug/l and Piezometer I-59, a shallow downgradient well, showed 7 ug/l. The rest of the well concentrations were less than the detection limit of 5 ug/l.

The only priority pollutant base-neutral compounds detected in Round 1 were bis(2-ethylhexyl)phthalate and trace amounts of two other phthalates. Only bis(2-ethylhexyl)phthalate was detected during Round 2 at one location. The chemical distribution map for Round 1 is shown on Figure III-10. Round 1 results showed bis(2-ethylhexyl)phthalate at five locations throughout the landfill area. The pattern was irregular and therefore not contoured. Piezometer D-90 showed 115 ug/l, while the background wells had concentrations less than the 1 ug/l detection limit. Piezometer D-92 had the highest level of 477 ug/l. The downgradient well mostly had concentrations either close to or below the detection limit.

Round 2 results showed bis(2-ethylhexyl)phthalate at only one location. As in Round 1, Piezometer D-92 had the highest level of 25 ug/l. All other wells showed concentrations less than the 10 ug/l detection limit.

The Round 1 results, in addition to providing priority pollutants concentrations, also provided information on possible additional organic compounds. Trace amounts of aliphatic hydrocarbons (also identified as diesel oil) were detected in Piezometer I-59 and S-80. An organic odor was evident in Piezometer S-80 during both sampling rounds. Most of the samples contained a variety of tentatively identified compounds such as phthalate esters, trimethyl cyclohexane-1-one, and other compounds found in plastics. The source of these compounds is unknown.

Phenol was detected at five locations in Round 1. Figure III-11 shows the distribution of phenol. The pattern is irregular and therefore not contoured. Piezometer D-92 had the highest concentration of 19 ug/l. The downgradient wells to the west of the landfill had concentrations of up to 7 ug/l. The detection limit was 1.7 ug/l.

Phenol was not detected in Round 2 above the detection limit of 10 ug/l. No other acid-extractable compound was detected. A general analysis of total phenolic compounds, a different analysis with detection limit of 2 ug/l, was negative.

Trace amounts of several pesticides were detected during Round 1. Compounds detected included gamma BHC (Lindane), delta BHC, chlordane, dieldrin, endrin, 4,4' DDD, 4,4' DDE, 4,4' DDT, and hexachlorobenzene. The compounds DDD and DDE are decomposition products of DDT. All wells tested positive for at least one pesticide. Piezometers S-82 and D-83, to the west of the landfill, showed the greatest numbers and highest concentrations of pesticides. All pesticide concentrations were less than 0.70 ug/l. The distribution of two frequently found pesticides, chlordane and 4,4' DDE, were plotted and shown on Figures III-12 and III-13. Chlordane was not detected in the upgradient wells, and shows an irregular pattern in the downgradient wells. Piezometer S-82 had a maximum concentration of 0.258 ug/l. The DDT decomposition product, 4,4' DDE, was found at 11 wells, both upgradient and downgradient of the landfill. The upgradient and background wells had higher concentrations. Piezometer D-89 had the maximum concentration at 0.117 ug/l. In general, the distribution of pesticides is irregular and the source is unknown. No pesticides were detected in Round 2. The detection limits in Round 2 were similar to those in Round 1.

elaborate not a problem

The distribution of inorganic constituents followed an undefined pattern as did the organic constituents. Total cyanide was detected at 1 or 2 ug/l levels at six locations during Round 1. The highest level was 6 ug/l at Piezometer D-90 to the south of the landfill area. In Round 2, total cyanide was detected in only one well above the 5 ug/l detection limit. Piezometer D-89 had the highest level at 7 ug/l. — Background well

→ not caused by landfill

The Round 1 metals ICP (Inductively Coupled Plasma) scan produced results for 32 dissolved metals. Conventional parameters such as iron and sodium were plotted to determine a pattern with respect to the landfill, since these compounds are often associated with landfill contamination. The distributions of sodium and iron are shown on Figures III-14 and III-15. The sodium concentration ranged from 5 mg/l to a high of 175 mg/l at Piezometer D-83. The ranges were generally between 30 and 70 mg/l both upgradient and downgradient of the landfill, with no distinct pattern. Levels were generally higher in the wells west of the landfill (over 100 mg/l). Dissolved iron distribution was also irregular. The highest concentration of 31.5 mg/l was found in Piezometer S-84. Levels were generally higher within the landfill boundary. Downgradient concentrations were slightly higher than upgradient concentrations.

In Round 1, very few priority pollutant metals were detected, except for copper and zinc. The distribution of zinc, which was found in almost all wells, is shown for Rounds 1 and 2 on Figures III-16 and III-17. The concentrations ranged from less than 2 ug/l in Piezometer D-90 to 1240 ug/l in the adjacent Piezometer S-51. Most other concentrations ranged from 30 to 140 ug/l throughout the landfill.

In Round 2, the detection limits for most metals were approximately one tenth the detection limits in Round 1. Even at detection limits of 1 to 4 ug/l, very few heavy metals were detected. The highest lead concentration was found at Piezometer D-91,to the south of the landfill. Compounds such as antimony, nickel, thallium, and zinc were commonly found. Silver was detected but at levels close to or below the detection limit of 2 ug/l. The distribution of zinc is shown on Figure III-19. As in Round 1, the lowest level of less than 2 ug/l was found in Piezometer D-90, while the highest level of 2000 ug/l was found in the adjacent Piezometer S-51. The remaining wells ranged between less than 2 and 70 ug/l throughout the landfill.

The distribution of the heavy metal arsenic was plotted, since several positive values were obtained. This is shown on Figure III-18. Piezometer D-91, a background well, contained 4 ug/l of dissolved arsenic. The maximum level of 9 ug/l was found in Piezometer S-84 and S-88.

Generally, the distribution of dissolved metals showed no distinct pattern and downgradient levels did not significantly differ from upgradient levels.

The significance of the chemical constituent concentrations will be discussed in Part IV.

In addition to priority pollutant analysis, four wells were also sampled for gross alpha and beta radiation during Round 1. The results are included in Appendix E. The values for gross alpha ranged from less than 2 pCi/l (pico curies per liter) in Piezometer D-83 to 270 pCi/l in Piezometer S-84. Piezometer S-84 had the only gross alpha or beta level exceeding 31 pCi/l. The laboratory explained that these high levels could have been due to the presence of suspended clay material in the sample, and that future samples should be filtered.

In May, 1986, 32 well samples were collected and analyzed for gross alpha and beta by the Department of Energy. The results are included in Appendix E. Further isotopic analyses are being performed on many of the samples.

Comments will be made in Appendix E.

(2) Vertical Distribution: The vertical distribution of chemical constituents was evaluated to determine:

(a) The presence of chemicals in the shallow and deep aquifers.

(b) Differences between the shallow and deep aquifers with respect to chemical constituents.

Organic chemicals were detected both in the shallow and deep part of the aquifer. In general, highest levels of methylene chloride were found in the deep piezometers, although only three piezometers had detectable levels in Round 2. Bis(2-ethylhexyl)phthalate was only found in deep piezometers in both Round 1 and Round 2. In Round 1, phenol was found in both shallow and deep piezometers. Pesticides were also found in both shallow and deep piezometers at similar concentrations.

Dissolved metals concentrations showed no definite pattern with respect to shallow and deep aquifer levels. In some well clusters, sodium was highest in the deep wells and in other well clusters sodium was highest in the shallow wells. The same was true for iron, zinc and many of the other detected metals. The well cluster of D-90 and S-51 consistently showed a low zinc level in the deep well and a high zinc level in the shallow well. The reason for this is uncertain, since this occurrence was inconsistent with other metals data but nonetheless is not at a level of concern.

b. Seasonal Variation

The sampling rounds occurred during two distinct seasons. Round 1 took place in December while Round 2 took place in May. In general, more chemicals were detected in Round 1, and at higher concentrations. Among those chemicals found to a greater extent in Round 1 were methylene chloride, bis(2-ethylhexyl)phthalate, phenol and pesticides. Priority pollutant metals were found more often in Round 2 because of the lower detection limits. Comparable metals such as zinc did not show substantial changes from Round 1 to Round 2.

c. Validity of Data

The validity of the chemical data is dependent on:

- The field collection of the water samples and proper preservation of the samples.
- The chemical laboratory quality assurance/quality control (QA/QC).

The organic data can be evaluated using the laboratory spike and blank and replicate sample data. During Round 1, the spike and duplicate sample results were within method accuracy limits. Bis(2-ethylhexyl)phthalate was detected in the blank at 3.5 ug/l.

The Round 2 laboratory volatile organic blanks contained 17 and 15 ug/l of methylene chloride. Trace concentrations of bis(2-ethylhexyl)phthalate were detected in the blanks.

The QA/QC information provided by the laboratories for Round 1 and Round 2 indicates that the sample data is reliable with respect to laboratory analysis. Possible interferences are methylene chloride and bis(2-ethylhexyl)phthalate. The Round 2 blank concentrations of methylene chloride may be high enough to cancel out the concentrations found in the three wells.

Field procedures could also have introduced an error factor to the chemical results. Common sampling errors are:

- o Introduction of surface contamination to the sample.
- o Improper cooling, storage and preservation.
- o Aeration of sample during collection.
- o Insufficient purging of stagnant well water.
- o Use of unclean sample bottles and sampling equipment.

Since precautions were taken to minimize these errors, the collected samples are probably representative of the aquifer water quality.

It should be noted that the Department of Energy samples, taken on May 7 and 8, 1986, were sampled by different personnel. The quality control of the filed procedures are unknown.

* * * * *

PART IV

IMPACT OF LANDFILL ON GROUNDWATER QUALITY

A. DOWNGRADIENT WATER USE

As described above in the discussion of regional groundwater hydrology, the discharge point for the groundwater downgradient beneath the old landfill site is the Missouri River. There are no water supply wells at the Earth City industrial park, and no known water supply wells elsewhere downgradient. The drainage ditches along St. Charles Rock Road intersect the water table. Therefore, the groundwater underflow beneath the site passes through the ditch~~h~~es as a surface water occurrence.

B. DOWNGRADIENT GROUNDWATER QUALITY

To assess the impact of the landfill on groundwater quality, the chemical constituent levels in the background wells were compared with levels within and downgradient of the landfill.

Methylene chloride was found in a background piezometer (D-91), an upgradient piezometer (D-89) and is also a possible laboratory interferent. It is unclear whether the landfill is a source of methylene chloride. ? not quite they were levels there in

Bis (2-ethylhexyl)pthalate was found in an upgradient (D-89) and is a possible laboratory interferent. Levels in Round 1 were generally highest within the landfill (D-92), and may therefore be affected by the landfill.

Phenol was found at its highest levels within the landfill area (D-92) and in downgradient piezometers and could therefore be affected by the landfill.

The various pesticides found in Round 1 showed no particular distribution pattern. Some were found more in the background wells (4, 4'DDE) and others in the downgradient wells (heptachlor, chlorodane). Levels tended to be highest in Piezometers S-82, D-83 and S-84, all downgradient. The effect of the landfill on pesticide levels is unclear, since none were detected in Round 2.

As mentioned earlier, the distribution of dissolved metals showed no particular pattern. Sodium levels tended to be higher in the interior and downgradient wells, as did iron levels. Other metals of concern did not appear to be affected by the landfill.

The chemical results suggest that certain wells showed relatively high levels of several constituents. During Round 1, Piezometer D-90 had the maximum concentrations for methylene chloride, total cyanide and also contained bis (2-ethylhexyl) pthalate. Piezometer D-92 had the maximum concentration of phenol and bis (2-ethylhexyl) pthalate and also contained methylene chloride.

During Round 2, Well D-89 had the maximum concentration of methylene chloride and bis (2-ethylhexyl) phthalate. [One possible source is the vehicle maintenance shop located near piezometer ~~D~~-89.]

Move to V-1

C. RISK ASSESSMENT

1. POTENTIAL PATHWAYS

The potential pathways of chemical transport from the landfill are the following:

- o Direct contact.
- o Air transport.
- o Surface water runoff.
- o Groundwater transport.

Direct contact and air transport would primarily affect persons working in and around in the landfill operation and were not considered major pathways. The risk is most likely similar to operations at most municipal landfills.

Surface water runoff from the landfill primarily flows to a drainage ditch along the north side of the landfill and the south side of St. Charles Rock Road. This ditch is also occasionally recharged with groundwater. This surface water either recharges the groundwater or discharges to the Missouri River. A pond along this ditch is located on the northwest side of the landfill, and is known to contain fish. Groundwater could potentially be affecting fish in this pond, but more data is needed to evaluate this possibility. Surface water runoff to the south and southwest flows out across relatively flat agricultural level, and some of this runoff may join the small intermittent creeks which traverse the area.

The groundwater pathway would affect persons using groundwater downgradient of the landfill before it discharges in the Missouri River. As discussed in Part IV, Section A, no private wells have been identified. The remote possibility of future wells being located down gradient of the site should be considered when evaluating the groundwater quality.

dilution factor - reduces risk factor downgradient

2. STATE AND FEDERAL WATER QUALITY CRITERIA

The concentration levels of various groundwater chemical constituents found during this investigation were compared with Federal and State drinking water quality standard and recommendations. The comparison is shown on Table IV-1. The compounds listed were the major detected compounds which have water quality standards and recommendations. The maximum, or worst case, concentrations were used to evaluate the groundwater quality.

According to the available data, most of the chemicals detected in the groundwater were at levels below drinking water quality limits and guidelines. Exceptions are phenol, chlordane, 4,4' DDT and cyanide.

Phenol was considerably below federal guidelines for health and aesthetics (taste and odor) but was greater than the drinking water limit of 1 ug/l. Chlordane was detected and therefore exceeded the proposed RMCC of 0 for potential carcinogens. The EPA Health Risk Criteria for 4,4'DDT is 0.00024 ug/l and was detected at 0.051 ug/l. Some decomposition products, 4,4'DDE and 4,4'DDD, were also detected. Total cyanide, at 7 ug/l exceeded the drinking water standard of 5 ug/l; however, the standard is based on cyanide amenable to chlorination. Arsenic, at 9 ug/l, exceeded the EPA Health Risk criteria for one in 100,000 cancer risk but was below the 50 ug/l drinking water standard.

TABLE IV-1

WATER QUALITY CRITERIA

Compound	Max. Conc. (ug/l)	Well No. Round	HRC	Water Quality Criteria (ug/l AWQL	MDNR	Other
Methylene Chloride	83	D-90(1)				600 (RSD) 150 (SNARL)
Bis (2-ethylhexyl) phthalate	477	D-92(1)		15,000		
Phenol	19	D-92(1)			1	4000 (RFD) 300 (T&O)
Gamma BHC- (Lindane)	0.100	S-82(1)	0.186			4 (DWS)
Chlordane	0.258	S-82(1)	0.23			8 (SNARL) 0 (RMCL)
Endrin	0.140	S-84(1)		1		0.2 (DWS)
4,4' DDT	0.051	D-83(1)	0.00024			
Cyanide	7	D-89(2)		200	5 (Amen to Cl)	
Arsenic	9	S-84,S-88(2)	0.0022 ?		50	50 (DWS) 50 (RMCL)
Cadmium	3	D-85(1)		10	10	10 (DWS) 5 (RMCL)
Lead	13	D-91(2)		50	50	50 (DWS) 20 (RMCL)
Silver	7	I-59,D-92(2)		50	50	50 (DWS)
Copper	57	I-59(1)			1000	1000 (T&O)
Nickel	62	S-82(2)		13,400		
Zinc	2000	S-51(2)			5000	5000 (T&O)

Note:

HRC - Health Risk Criteria: Cancer Risk per 100,000 population (Fed. Reg. 11/28/80)
AWQL - Ambient Water Quality Criteria (Fed. Reg. 11/28/80)
MDNR - Missouri Department of Natural Resources - Drinking Water Limits
RSD - Risk Specific Dose: Cancer Risk per 100,000 pop. (Fed. Reg. 613186)
RFD - Risk Factor Dose: (Fed. Reg. 613186)
T&O - Taste and Odor Recommendations
SNARL - Suggested No Adverse Response Levels, Long Term
DWS - U.S.E.P.A. Drinking Water Standard
RMCL - Recommended Maximum Contaminant Level (proposed - Fed. Reg. 11/13/85)

PART V

CONCLUSIONS

A. SUMMARY OF HYDROGEOLOGICAL CONCLUSIONS

Based upon information from the Burns & McDonnell investigation of the West Lake Landfill site it can be concluded that:

The alluvium of the Missouri River forms the major aquifer in the vicinity of the site. The underlying bedrock is relatively impermeable, both on the valley side slopes and the bedrock valley floor buried beneath the alluvium.

Alluvial deposits of the Missouri River are in hydraulic communication with the river, thus the river has a major influence on water levels in the alluvium. A rise in river stage during seasons of high rainfall and snow melt causes the water table in the aquifer to rise. Conversely a seasonal drop in the river stage causes the water table in the aquifer to drop. Although the rise and fall of the aquifer is less than that of the correlative change in river stage, the change in water table elevation is relatively uniform throughout the entire extent of the aquifer in the site vicinity.

The predominant direction of groundwater flow in the aquifer in the region near the site is northwestward toward the Missouri River. This predominant, regional pattern of flow is illustrated on Figure IN-1, which was made using water levels in piezometers in the Earth City area in 1976. There are broad fluctuations in this flow direction throughout the year and the predominant flow direction ranges from slightly south of due west to northwest (subparallel to the northerly flow direction of the Missouri River). During short periods of the year (primarily in the spring and for short periods in winter), when the river stage is rising rapidly, the predominant groundwater flow direction in the aquifer may be temporarily reversed in the localized vicinity of the river. This occurs while the river is at a higher elevation than the water table. This generally eastward flow is of short duration and is overshadowed by the predominant westward flow at some distance from the river.

Throughout most of its extent, the aquifer is generally unconfined (under water table conditions). Relatively low-permeability, discontinuous clayey and silty zones in the upper part of the alluvium may cause semiconfined and perched water conditions in very localized areas.

Other localized effects, of only minor significance, may affect groundwater flow directions in the aquifer. As can be seen on Figure III-1 the only local feature of note is a perennial groundwater mound, superimposed on the generally westward sloping water table which predominates on the rest of the site. The groundwater mound is located on the southern part of the West Lake site, and occurs due to a localized recharge zone. This mounding is created by: (1) water pumped from the quarry being discharged at the ground surface above the mound, (2) surface infiltration from the drainage ditches along Old St. Charles Rock Road after rainfall (illustrated by cross-hatching on Figure III-1, (3) and possible leakage from the surface water holding ponds immediately west of the existing quarry (also illustrated by cross-hatching on Figure III-1. This mound generally affects flow direction only in the upper portion of the aquifer, but may result in a significant vertical component of flow beneath the mound. The mounding effect is superimposed on the effect caused by changes in river stages and the effect of the bedrock valley. In the bulk of the aquifer, other than beneath the mound, the vertical component of flow is insignificant.

In the area of the groundwater mound, flow direction in the upper portion of the aquifer is to the south, west and north away from the mound. Flow direction lower in the aquifer includes a major component that is vertically downward near the valley wall, but is horizontal either toward or subparallel to the Missouri River at some distance from the valley wall.

Gradients in hydraulic head in the lower aquifer are, at times, extremely low. See, for example, Figure III-5. Thus, minor fluctuations in head (in the range of 1/10-foot) may be sufficient to cause ~~major~~ changes in flow direction. But because the gradients are very low at such times, groundwater flow rates are negligible.

At other times (see for example, Figure III-7), there may be two to three feet of differential in hydraulic head across the site. The pattern in hydraulic head distribution in the deep aquifer at such times is seen to reflect approximately the same pattern as the head distribution in the shallow aquifer (see Figure III-4). Thus, the surface water features which recharge the shallow part of the aquifer and cause groundwater ____?____ in the southeastern part of the site also recharge the deeper part of the aquifer by vertical infiltration from above. During such times, groundwater flow in the deep portion of the aquifer is laterally, away from the recharge area, predominantly to the west and northwest. During all times of measurement, the hydraulic gradients in the deeper part of the aquifer were substantially less than that in the shallow part of the aquifer.

Piezometers D-89 and I-73 are in the upgradient portion of the site, in the vicinity of the predominant recharge area of the site. Piezometers I-50 and D-91 are in an area south of the landfill where they are outside the area of influence of the groundwater flow pattern of the site. Thus, the groundwater in the aquifer there is not downgradient of the site, but is recharged from elsewhere, and samples from these wells may be considered background water quality samples for the aquifer. The surface water drainage ditches along the northern edge of the site are interconnected with the water table, and are in the downgradient area of the groundwater flow pattern. Thus, they contain not only surface water runoff, but also underflow of groundwater from the aquifer.

Based on an interpreted value of hydraulic gradient of 0.003 across the site, (considering the fan-shaped flow pattern diverging from the groundwater around beneath the landfill), a value of 6.35×10^{-4} cm/sec for hydraulic conductivity of aquifer materials, a saturated thickness of 95 feet, and a site perimeter length of 6900 feet, the flow rate is calculated to be 27,000 gallons per day beneath the entire site. For an assumed value of 0.20 for effective porosity, the groundwater flow velocity is calculated to be 75 feet per year.

B. SUMMARY OF GROUNDWATER QUALITY

1. Methylene chloride was the only detected priority pollutant volatile organic chemical. In Round 2, the detection of methylene chloride was accounted for by its concentration in blank samples.

2. During Round 1, methylene chloride had a maximum concentration in Piezometer D-90.

3. The compounds bis(2-ethyl hexyl) phthalate and phenol were found at the maximum concentration at Piezometer D-92 during Round 1.

4. The general distribution of organic constituents was scattered and irregular. In general, phenol and methylene chloride were found to be slightly higher in downgradient wells during Round 1. The landfill is a possible, but not certain, contributor.

5. The distribution of dissolved metals was irregular and significant differences were not detected between the background, upgradient and downgradient wells.

6. Many chemical constituents were detected in the deep wells but no significant increase was detected between the deep wells and the shallow wells.

7. More chemicals were detected during Round 1 (December 1985) at greater concentrations than during Round 2 (May 1986).

8. A variety of pesticides were detected during Round 1 at various locations, especially Piezometers S-82, D-83 and S-84. The source of these pesticides is unknown. No detection in Round 2

9. Compared to state and federal drinking water standards, the levels of chemicals found in the groundwater do not appear excessive. Some of the pesticides, such as chlordane and 4,4' DDT, exceeded recommended levels for cancer risk. No detection in Round 2

10. Surface water and groundwater are connected in the drainage ditch running along the north side of the landfill. A pond connected to this ditch, located on the northwest side of the landfill, contains fish which could be affected by the groundwater.

11. No water supplies using groundwater downgradient of the landfill have been found.

C. PROPOSED GROUNDWATER MONITORING PROGRAM

The purpose of the proposed groundwater monitoring plan is to evaluate the effect of the landfill on groundwater quality through long-term monitoring. Certain constituents detected during this investigation will ~~also~~ be resampled to clarify differing results between Round 1 and Round 2.

The components of the proposed plan are as follows:

1. <u>SHORT-TERM MONITORING</u>

The following piezometers will be resampled and analyzed for the listed constituents:

I-59: Volatile Organics

D-81: Volatile Organics

S-82: Pesticides

D-83: Volatile Organics

S-84: Pesticides

D-87: bis(2 ethylhexyl) pthalate

D-89: bis(2 ethylhexyl) pthalate, volatile organics

D-90: bis(2 ethylhexyl) pthalate, volatile organics

D-92: bis(2 ethylhexyl) pthalate, volatile organics

Based on this data, the long-term monitoring plan will be revised appropriately.

Also, because of the presence of fish in the surface pond to the west of the landfill, ,the fish should be sampled and analyzed for the following constituents:

Priority pollutant pesticides

Priority pollutant metals

gross alpha and beta radiation

From this data, a decision can be made on whether or not fishing should be allowed in this pond.

MDNR ?

2. LONG-TERM MONITORING

The following piezometers shall be sampled on a quarterly basis:

S-84, D-85: north of landfill

S-82, D-93: west of landfill

D-89: upgradient

D-91: background

D-92: within landfill boundary

Reference should be attached *

The samples will be analyzed according to MDNR parameters for landfill monitoring. In addition, the water level will be measured in each well before sampling.

study

An analysis of the results will determine if future remedial action is needed at the site.

Change wording

REFERENCES

3. Anderson, Kenneth, et al, Geologic Map of Missouri: Missouri Geological Survey and Water Resources. Scale 1:500,000. 1979.

4. Koenig, John W., The Stratigraphic Succession in Missouri, Missouri Geological Survey Bulletin 15, 2nd Series. 1961.

5. Miller, Don E., et al, Water Resources - St. Louis Area, Missouri, Water Resources Report No. 30, Missouri Geological Survey and Water Resources and the U.S. Geological Survey, 1974.

6. Gann, E. E., et al, Water Resources of Northeastern Missouri, Hydrologic Investigations Atlas HA-372, U.S. Geological Survey and the Missouri Geological Survey and Water Resources, 1971.

* * * * *

APPENDIX A

CRITERIA FOR LOGGING OF SOIL AND ROCK BORING LOGS

LEGEND AND NOMENCLATURE OF DRILLING LOGS

Information preceeding the logs relates to pertinent project and boring descriptions, which are self-explanatory. Remaining items on drilling logs are described as follows:

1) DEPTH: Depth below a given reference elevation. Normally, units are in feet and are from the aforementioned ground surface, unless otherwise noted.

2) DESCRIPTION: Description of soil or rock material according to Unified Soil Classification. Word descriptions give principal soil constituent, other minor soil constituents, color, moisture, consistency or density, plasticity, and other appropriate material characteristics. Geologic names, where appropriate, are shown in REMARKS. A solid line denotes a stratigraphic change, a dashed line indicates the approximate location of a stratigraphic change. Rock samples are described according to lithology, color, moisture content, weathering, strength, and any discernible structure. Criteria for evaluating weathering and strength (established by the U.S. Bureau of Mines,) are as follows:

Weathering:

FR: (Fresh) No visible signs of weathering.

SW: (Slightly Weathered) Weathering (alteration) limited to the surface of major discontinuities, no weathering of rock material.

MW: (Moderately Weathered) Weathering (alteration) extends throughout the rock mass, but the rock material is not friable.

HW: (Highly Weathered) Rock is decomposed and friable, but the rock texture and structure are preserved.

XW: (Extremely Weathered) Soil material with the original texture, structure, and mineralogy of the rock completely destroyed.

Strength: VS: (Very Strong) Rock surfaces cannot be scratched by a steel nail.

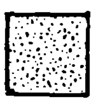
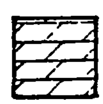
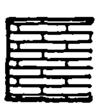
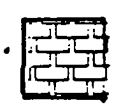
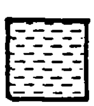
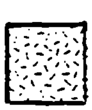
S: (Strong) Faint scratch made with a steel nail.

MS: (Moderately Strong) Distinct scratch trace made with a steel nail.

W: (Weak) Slight scratch left by fingernail, material can be gouged out with steel nail.

VW: (Very weak) Material can be gouged out with fingernail.

3) <u>LOG OR CLASSIFICATION</u>: Unified Soil Classification symbols are shown in reference to appropriate description of soil. Rock material is noted by visual symbols (referenced from NAVFAC DM-7 Manual, March 1971, with slight revision) representing rock classification, as shown below:

	SANDSTONE		SILTSTONE
	CONGLOMERATE		MUDSTONE
	COAL		DOLOMITE
	LIMESTONE		CHALK
	COMPACTION SHALE		CEMENTED SHALE
	GNEISS		SCHIST
	GRANITE		BASALT

4) BLOW COUNT: (ie: 4/7/8)

Numbers indicate the necessary blows to drive 3 six-inch increments, or part thereof, of a split barrel sampler when driven by a 140-pound hammer falling freely for 30 inches: as per ASTM D 1586. The Standard Penetration Resistance (N value) is the sum of the second and third six-inch penetrations. If the sampler is driven less than 18 inches, the N value is represented by the total resistance over the last 12 inches. If the sampler is driven less than 12 inches, logs indicate the number of blows and fraction of increment in inches actually penetrated. Note that a blow count can be listed for a California or Dames & Moore sampler, but that this is not the Standard Penetration Resistance.

5) RECOVERY & LOSS: In soil this represents the total length of soil recovered over the amount of sample penetrated. In rock this notes the percent core recovery and Rock Quality Designation (RQD).

6) SAMPLE DEPTH: A column that provides a reference to the depth below the previously mentioned reference elevation at which samples were taken.

7) BOX SAMPLE NO: In the case of rock coring, the box number and core run number are noted. For soils, the designated type and consecutively numbered sample are noted by the following letter;

SS - Split-Spoon sample, obtained by driving a 2-inch diameter split spoon according to D 1586 to retreve penetration resistance and sample recovery.

ST - Undisturbed thin-walled tube sample (Shelby Tube) D 1587, obtained by penetration of a 3-inch diameter thin-walled tube using an open or, where indicated, fixed piston sampling head.

C - Continuous sampler: obtained by drilling a 5-foot long, 2½-inch I.D., CME split barrel sampler into the soil material.

DM - Liner tube sampler (Dames & Moore), obtained by penetration of a thick-walled, split-barrel sampler containing 2½-inch diameter ring liners.

B - Bag Sample, obtained by combining disturbed auger cuttings for a large bag sample.

D - Disturbed Sample, obtained from auger cuttings or wash water for a small container sample.

-J - Jar Sample, obtained from any other sample method, but later placed into a jar container due to sample size or disturbance.

8) REMARKS: Pertinent observations made and noted by the inspector during drilling. These may include, but are not restricted to, type of drilling, water seepage, fluid loss, time during drilling, material formation, hole termination, pocket penetrometer readings (TSF), piezometer installation, water levels first encountered during drilling and at some time after completion of drilling, and any other pertinent information.

9) SOIL STRENGTH: Q_p is the designation of soil strength as measured with a pocket penetrometer. Units are in tons per square foot.

Drilling Log

Project Name	WESTLAKE	Boring No.	S-80
Project No.	84-075-4-002	Page	1 of 2
Ground Elevation 448.4	Location N. 2592.7962, E. 2619.0159	Total Footage	22.0

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
SOLID AUGERS	5"	22.0'	0	4	0	SEE REMARKS	–

Drilling Co.	WABASH DRILLING CO.	Driller (s)	DORL THORNTON
Drilling Rig.	ACKER MP-5, TRUCK	Type of Penetration Test	STANDARD
Date 8-28-84	To 8-29-84	Field Observer (s)	GLEN ERNSTMANN

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
0–1	DARK BROWN SANDY SILT AND ORGANIC MATTER, DAMP						5" SOLID AUGERS 0' TO 20'.
1–6.5	LIGHT BROWN FINE SANDY SILT, LOW PLASTICITY, VERY LOOSE, DAMP						
5.0–6.5			2/2/1	8"/18"	5.0 – 6.5	SS-1	
6.5–13	GRAY-BROWN SILTY CLAY, MEDIUM PLASTICITY, MEDIUM STIFF TO SOFT, MOIST						
10.0–11.5			1/3/2	18"/18"	10.0 – 11.5	SS-2	
13–	GRAY-BROWN FINE SANDY SILT, SOME CLAY, VERY SOFT, SATURATED						

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. S-80
Project Name WESTLAKE	Page 2 of 2
Project No. 84-075-4-002	Date 8-28-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
15	GRAY-BROWN FINE SANDY SILT, SOME CLAY, VERY SOFT, SATURATED				15.0		SATURATED MATERIAL @ APPROX. 14'.
16				16" / 24"		ST-3	Q_p = 0.0 TO 0.5 TSF
17					17.0		STOPPED 8-28-84 RESUMED 8-29-84
18	GRAY SILTY CLAY, MEDIUM TO HIGH PLASTICITY, MEDIUM STIFF, SATURATED						WATER ENTERED HOLE TO A DEPTH OF 13.5' AFTER SAMPLE ST-3 WAS OBTAINED.
19							WATER LEVEL BEFORE DRILLING 7:00am 8-29-84 ; 12.9' BELOW G.S.
20					20.0		
21				24" / 24"		ST-4	Q_p = 0.6 TSF
22					22.0		
23	TOTAL DEPTH 22.0'						
24							A 2" dia. PVC piezometer was installed to 20'.
25							1' of clay cuttings and 1' of bentonite pellets were implaced in bottom of hole.
26							PVC is flush-jointed threaded couplings.
27							Bottom 10' is .010" machine slotted screen.
28							Bottom 11' is gravel packed with a 2' thick bentonite pellet seal above.
29							Anulus is grouted from seal to surface.
30							T.O.P. is 5' above G.S. WATER LEVEL IS 18.17' BELOW T.O.P. IMMEDIATELY AFTER PIEZOMETER INSTALLATION 7:05 am 8-29-84

WATER LEVEL @ 17.4' BELOW T.O.P. AFTER PUMPING WATER INTO PIEZO. 9:30 am 8-29-84

111479

Barns & McDonnell
Engineers-Architects-Consultants

Form TS-GT-2-2

Drilling Log

Project Name	WESTLAKE	Boring No.	D-81
Project No.	84-075-4-002	Page	1 of 4
Ground Elevation	447.8	Location	N. 1146.2728, E. 922.0145
Total Footage	61.5'		

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
SEE REMARKS	SEE REMARKS	61.5	0	11	0	SEE REMARKS	—

Drilling Co.	WABASH DRILLING CO.	Driller (s)	DORL THORNTON
Drilling Rig.	ACKER MP-5, TRUCK	Type of Penetration Test	STANDARD
Date	8-13-84 To 8-15-84	Field Observer (s)	GLEN ERNSTMANN

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
1	BROWN FINE SANDY SILT, LOW PLASTICITY, DAMP (FILL)						5" SOLID AUGERS 0' TO 15'
2							
3	GRAY-BROWN COARSE GRAVEL (MAX, 2" DIA.), SOME FINE GRAVEL AND SAND, DAMP (FILL)						
4							
5							
6							
7	BROWN CLAYEY SILT, LOW PLASTICITY, DAMP TO MOIST (FILL)						
8							
9							
10	BROWN FINE TO MEDIUM SAND, MEDIUM DENSE TO LOOSE, DAMP (FILL)		5/5/4	16"/18"	10.0	SS-1	
11	BROWN CLAYEY SILT, LOW PLASTICITY MOIST (FILL)				11.5		STOPPED 8-13-84 RESUMED 8-14-84
12	BROWN SILTY FINE TO MEDIUM SAND, MEDIUM DENSITY, SATURATED BELOW APPROX. 13'. (FILL ?)						
13							SATURATED MATERIAL FIRST ENCOUNTERED @ APPROX. 13'

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-81
Project Name WESTLAKE	Page 2 of 4
Project No. 84-075-4-002	Date 8-13-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
15–16.5	BROWN SILTY FINE TO MEDIUM SAND, MEDIUM DENSE SATURATED BELOW APPROX. 13' (FILL(?)		3/5/7	14"/18"	15.0–16.5	SS-2	BEGAN 4½" DIA. TRI-CONE, WASH BORING @ 15'. CONTINUED TO 61.5'.
18–20	BROWN FINE TO MEDIUM SAND, WELL SORTED, SUBROUNDED GRAINS, MEDIUM DENSITY, SATURATED						
20–21.5			6/10/16	10"/18"	20.0–21.5	SS-3	
25–26.5			9/14/15	10"/18"	25.0–26.5	SS-4	
28–30	GRAY FINE SAND, TRACE SILT, SAND IS HIGHLY QUARTZOSE, MEDIUM DENSE, SATURATED						
30–			10/12/5	11"/18"	30.0	SS-5a	

Drilling Log (continued)

	Boring No. D-81
Project Name WESTLAKE	Page 3 of 4
Project No. 84-075-4-002	Date 8-13-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	GRAY SILTY CLAY MEDIUM TO HIGH PLASTICITY, STIFF TO MEDIUM STIFF, MOIST TO SATURATED				31.5	SS-5B	
32							
33							
34	GRAY SILT AND SAND INTERBEDS, SILT IS LOW PLASTICITY, VERY LOOSE, SATURATED						
35					35.0		
36			*0/1/4	*0"/18"	36.5	SS-6	*NOTE: RODS SUNK 6" WHEN SAMPLE SS-6 WAS FIRST ATTEMPTED. NO RECOVERY ON FIRST ATTEMPT SO RODS WERE DROPPED BACK DOWN THE HOLE AND A SAMPLE OBTAINED.
37							
38							
39							
40					40.0		
41				18"/18"	41.5	ST-7	Q_p = N.A.
42	GRAY FINE TO COARSE SAND, SUBANGULAR TO SUBROUNDED GRAINS, HIGHLY QUARTZOSE, SATURATED						
43							
44	GRAY SAND AND GRAVEL (1" MAX.) SATURATED						
45					45.0		
46	GRAY COARSE SAND, SOME MEDIUM AND FINE, SUBROUNDED TO SUBANGULAR, DENSE		15/20/18	7"/18"	46.5	SS-8	
47							
	(SEE DESCRIPTION BELOW)						

Drilling Log (continued)

	Boring No. D-81
Project Name WESTLAKE	Page 4 of 4
Project No. 84-075-4-002	Date 8-13-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
49	GRAY SAND AND FINE GRAVEL INTERBEDS, SAND IS FINE TO COARSE, SUBROUNDED, QUARTZOSE GRAVEL IS SUBANGULAR TO SUBROUNDED, QUARTZ, FELDSPAR AND SOME MAFIC MINERALS, DENSE TO VERY DENSE, SATURATED						
50			15/18/22	10"/18"	50.0	SS-9a	← GRAVEL
51						SS-9b	← SAND
52					51.5		
53							
54							
55			13/21/37	9"/18"	55.0	SS-10	A 2" dia. PVC piezometer was installed to 60'. PVC is flush-joint, threaded couplings. Bottom 15' is .010" machine slotted screen. Bottom 17.5' is gravel packed with a 3' thick bentonite pellet seal above. Annulus is grouted from seal to ground surface. T.O.P. is 3' above ground surface.
56					56.5		
57							
58							
59	GRAY-BROWN FINE TO MEDIUM SAND, VERY DENSE, SATURATED						
60			14/20/44	8"/18"	60.0	SS-11	
61					61.5		
62	TOTAL DEPTH: 61.5'						WATER LEVEL IS @ 16.63' BELOW T.O.P. 3:05pm 8-15-83 (4 hrs. after installation)
63							
64							

Drilling Log

Project Name	Boring No.
WESTLAKE	S-82

Project No.	Page	of
84-075-4-002	1	2

Ground Elevation	Location	Total Footage
447.7	N. 599.1580, E. 19.3231	26.5'

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
SEE REMARKS	SEE REMARKS	26.5'	0	5	0	SEE REMARKS	–

Drilling Co.	WABASH DRILLING CO.	Driller (s)	DORL THORNTON
Drilling Rig.	ACKER MP-5, TRUCK	Type of Penetration Test	STANDARD
Date	8-24-84 To 8-27-84	Field Observer (s)	GLEN ERNSTMANN

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
0–1							5" SOLID AUGERS 0' TO 20'.
1–2	BROWN SANDY CLAY, SOME GRAVEL, MEDIUM PLASTICITY, STIFF TO VERY STIFF, DAMP TO MOIST (FILL)						
5.0–6.5			5/4/8	14"/18"	5.0 – 6.5	SS-1	
8.5–9	BROWN FINE SANDY SILT, LOW TO NON-PLASTIC, STIFF, MOIST TO SATURATED						SATURATED MATERIAL ENCOUNTERED @ 11' TO 13'. UNSATURATED 13' TO 17',
10.0–11.5			2/3/3	17"/18"	10.0 – 11.5	SS-2	
13	LIGHT BROWN FINE TO MEDIUM SAND, DAMP						

TECHNICAL SERVICES
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Drilling Log (continued)

	Boring No. 5-82
Project Name WESTLAKE	Page 2 of 2
Project No. 84-075-4002	Date 8-27-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	LIGHT BROWN FINE TO MEDIUM SAND, DAMP						
15	BROWN SILTY CLAY, MEDIUM PLASTICITY, VERY STIFF, MOIST		3/7/13	16"/18"	15.0		
16						SS-3	
					16.5		
17	BROWN-GRAY SILTY FINE TO MEDIUM SAND, MEDIUM DENSITY, SATURATED						SATURATED MATERIAL BELOW APPROX. 17' TO 18'.
18							
19							CASING WAS DRIVEN TO 20' & HOLE WAS WASH-BORED FROM 20' TO 25'.
20			4/7/12	15"/18"	20.0		
21						SS-4	
					21.5		STOPPED 8-24-84
22							RESUMED 8-27-84
							NOTE: HOLE HAS COLLAPSED TO 13.3' BELOW G.S. OVER THE WEEKEND.
23	GRAY-BROWN COARSE SAND, SOME FINE TO MEDIUM SAND, MEDIUM DENSITY, SATURATED						
24	PRIMARILY QUARTZ, SOME CHERT FRAGMENTS AND MAFIC MINERALS						A 2" dia. PVC piezometer was installed to 25.5'
25			7/14/29	17"/18"	25.0		PVC is flush-jointed, threaded Couplings.
26						SS-5a	
	GRAY, SILTY FINE TO MED. SAND, SATURATED				26.5	SS-5b	Bottom 10' is .010" machine slotted screen.
27	TOTAL DEPTH 26.5'						Bottom 12.5' is gravel packed with a 2' thick bentonite pellet seal above.
28							Anulus is grouted from seal to surface.
29							T.O.P. is 3.0' above ground surface.
30							WATER LEVEL IS 18.2' BELOW T.O.P. IMMEDIATELY AFTER PIEZOMETER INSTALLATION 1:45pm 8-27-84.

Drilling Log

Project Name		Boring No.
WESTLAKE		D-83
Project No. 89-075-4-002		Page 1 of 7
Ground Elevation 444.4	Location N. 1742.7093, E. 1219.6580	Total Footage 115.3

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
SEE REMARKS	SEE REMARKS	115.3	0	16	0	SEE REMARKS	—

Drilling Co. WABASH DRILLING CO.	Driller (s) DORL THORNTON
Drilling Rig. ACKER MP-5, TRUCK	Type of Penetration Test STANDARD
Date 8-16-84 To 8-20-84	Field Observer (s) GLEN ERNSTMANN

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
0–1	BROWN FINE SANDY SILT AND ORGANIC MATERIAL, DAMP						5" DIA. SOLID AUGERS 0' TO 15'.
1–3	BROWN SILTY FINE SAND, DAMP						
3–13	LIGHT BROWN FINE TO MEDIUM SAND, TRACE SILT, LOOSE TO MEDIUM DENSITY, DAMP SATURATED BELOW APPROX. 10.5'						
5.0–6.5			3/3/3	17"/18"	5.0 – 6.5	SS-1	
10.0–11.5			3/4/8	16"/18"	10.0 – 11.5	SS-2	SATURATED MATERIAL ENCOUNTERED @ APPROX. 10.5'
13–	LIGHT BROWN FINE SAND INTERBEDDED WITH THIN (3" TO 6") CLAY SEAMS, SATURATED						

TECHNICAL SERVICES
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Drilling Log (continued)

	Boring No. D-83
Project Name WESTLAKE	Page 2 of 7
Project No. 84-075-4-002	Date 8-16-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
14–15	LIGHT BROWN FINE SAND INTERBEDDED WITH THIN (3" TO 6") CLAY SEAMS, SATURATED						BEGAN 4½" DIA. TRI-CONE WASH BORING @ 15' TO 115.3'.
15	BROWN SILTY CLAY, MEDIUM PLASTICITY, MOIST		4/10/15	15"/18"	15.0	SS-3a	
16	LIGHT BROWN FINE TO MEDIUM SAND, TRACE SILT, MEDIUM DENSITY, SATURATED				16.5	SS-3b	STOPPED 8-16-84 RESUMED 8-17-84
17							
18							
19	FINE TO COARSE SAND AND FINE GRAVEL, SATURATED						
20	BROWN TO GRAY FINE TO MEDIUM SAND, TRACE SILT, DENSE, SATURATED		14/19/24	15"/18"	20.0	SS-4	
21					21.5		
22							
23	GRAY-BROWN MEDIUM TO COARSE SAND, SOME FINE SAND, FEW THIN (3" TO 8" THICK) FINE GRAVEL SEAMS (3/4" MAX. DIA.), MEDIUM DENSE						
24							
25	SAND IS PRIMARILY QUARTZ, SOME FELDSPAR AND MAFIC MINERALS, SUBROUNDED TO SUBANGULAR GRAINS		9/10/10	13"/18"	25.0	SS-5	
26					26.5		
27							
28							
29							
30	GRAY FINE TO MEDIUM SAND, TRACE SILT AND COARSE SAND, PRIMARILY QUARTZ, DENSE, SATURATED		10/15/17	8"/18"	30.0	SS-6	

TECHNICAL SERVICES
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Drilling Log (continued)

	Boring No. D-83
Project Name WESTLAKE	Page 3 of 7
Project No. 84-075-4-002	Date 8-16-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
					31.5	SS-6	
32	GRAY FINE TO MEDIUM SAND, TRACE SILT AND COARSE SAND, PRIMARILY QUARTZ SAND, DENSE, SATURATED						
33							
34							
35			9/15/21	9"/18"	35.0	SS-7	
36					36.5		
37							
38							
39	GRAY-BROWN MEDIUM TO COARSE SAND, FEW FINE GRAVEL SEAMS, PRIMARILY QUARTZ, WITH SOME FELDSPAR, SUBROUNDED TO SUBANGULAR GRAINS, DENSE, SATURATED						
40			10/13/17	8"/18"	40.0	SS-8	
41					41.5		
42							
43							
44	GRAY-BROWN FINE TO COARSE SAND AND FINE TO COARSE GRAVEL (3" MAX. DIA.), QUARTZ, FELDSPAR, AND MAFIC MINERALS, SUBANGULAR GRAINS, MEDIUM DENSE, SATURATED						
45			12/10/11	9"/18"	45.0	SS-9	
46					46.5		
47							

TECHNICAL SERVICES
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Drilling Log (continued)

	Boring No. D-83
Project Name WESTLAKE	Page 4 of 7
Project No. 84-075-4-002	Date 8-16-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	GRAY-BROWN FINE TO COARSE SAND AND FINE TO COARSE GRAVEL AS DESCRIBED ABOVE						
49							
	GRAY FINE TO COARSE SAND, MEDIUM DENSITY, SATURATED						
50					50.0		
51			4/7/11	8" / 18"		SS-10	
					51.5		
52							
53							
54							
55							
56							
57							
58							
	SAND AND GRAVEL, SATURATED						
59							
60					60.0		
	GRAY SILTY FINE TO MEDIUM SAND, PRIMARILY QUARTZ, VERY DENSE, SATURATED		35/50/5"	7" / 11"		SS-11	
61					60.9		
	SEVERAL THIN (3" TO 6" THICK) FINE TO COARSE GRAVEL SEAMS						
62							
63							
64							

TECHNICAL SERVICES
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Drilling Log (continued)

	Boring No. D-83
Project Name WESTLAKE	Page 5 of 7
Project No. 84-075-4-002	Date 8-16-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
66	GRAY SILTY FINE TO MEDIUM SAND, PRIMARILY QUARTZ, VERY DENSE						
67–68	SEVERAL THIN (3" TO 6" THICK) FINE TO COARSE GRAVEL SEAMS AND COARSE SAND SEAMS						
69							
70–71			14/19/22	7"/18"	70.0–71.5	SS-12	
72–76							
77–79	GRAY-BROWN COARSE SAND, SOME FINE TO MEDIUM SAND AND FINE GRAVEL, QUARTZ, FELDSPAR AND SOME MAFIC MINERALS, SUBROUNDED, MEDIUM DENSITY TO DENSE, SATURATED						NOTE: SLIGHT ORGANIC OR LEACHATE-LIKE ODOR IN SAMPLES SS-12 & SS-13
80–81			13/14/14	8"/18"	80.0–81.5	SS-13	

Drilling Log (continued)

	Boring No. D-83
Project Name WESTLAKE	Page 6 of 7
Project No. 84-075-4-002	Date 8-16-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
83							
84	GRAY-BROWN COARSE SAND, SOME FINE TO MEDIUM SAND AND FINE GRAVEL, QUARTZ, FELDSPAR, AND SOME MAFIC MINERALS, SUBROUNDED, MEDIUM DENSITY TO DENSE, SATURATED						
85							
86							
87							
88							
89							
90			14/16/17	8" / 18"	90.0	SS-14	NOTE: MODERATE TO STRONG LEACHATE-LIKE ODOR IN SAMPLE SS-14
91					91.5		
92	OCCASIONAL GRAVEL SEAM (3" TO 4" THICK), 92' TO 104'.						
93							
94							
95							
96							
97							
98							

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-83
Project Name WESTLAKE	Page 7 of 7
Project No. 84-075-4-002	Date 8-16-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
100	GRAY-BROWN COARSE SAND, SOME FINE TO MEDIUM SAND AND FINE GRAVEL, QUARTZ, FELDSPAR AND SOME MAFIC MINERALS, SUBROUNDED, MEDIUM DENSE TO DENSE, SATURATED		18/26/26	9"/18"	100.0	SS-15	SLOWER DRILLING RATE 90' TO 100'.
101					101.5		STOPPED 8-17-84 RESUMED 8-20-84
102	OCCASIONAL GRAVEL SEAM (3" TO 4" THICK), 92' TO 104'.						
103							MUCH SLOWER DRILLING RATE 100' TO 115.3'.
104							
105							A 2" dia. PVC piezometer was installed to 97'. PVC is flush-jointed, threaded couplings. Bottom 20' is .010" machine slotted screen.
106							
107							Gravel 115.3' to 100'. Bentonite pellets 100' to 99'. Gravel pack 99' to 75.5' with a 2' thick bentonite pellet seal above. Anulus is grouted from seal to ground surface.
108							
109							
110	— — — — — — —				110.0		
111	GRAVEL AND SAND, SOME SILT, DENSE, SATURATED		24/22/27	3"/18"	111.5	SS-16	T.O.P. is 3.2' above ground surface.
112							
113							
114							WATER LEVEL IMMEDIATELY AFTER PIEZOMETER INSTALLED (2:05pm 8-21-84) is 14.50' BELOW T.O.P.
115							
	CREAM LIMESTONE						
	TOTAL DEPTH 115.3'						

Drilling Log

Project Name	WESTLAKE	Boring No.	S-84
Project No.	84-075-4-002	Page	1 of 3
Ground Elevation 452.9	Location N. 340.0038, E. 1998.2729	Total Footage	31.5'

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
SEE REMARKS	5"	31.5	0	4	0	SEE REMARKS	—

Drilling Co.	WABASH DRILLING CO.	Driller (s)	DORL THORNTON
Drilling Rig.	ACKER MP-5, TRUCK	Type of Penetration Test	STANDARD
Date	8-24-84 To 8-24-84	Field Observer (s)	GLEN ERNSTMANN

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
1	LIGHT BROWN SAND, SILT AND GRAVEL, DAMP TO DRY (FILL)						5" DIA. SOLID AUGERS 0' TO 30'.
2							
3							
4	GREENISH GRAY TO DARK GRAY SILTY FINE SAND, VERY LOOSE, DAMP (FILL)						
5					5.0		
6			2/2/2	18"/18"		SS-1	
7					6.5		
8							
9							
10							
11							FEW THIN SATURATED SANDY ZONES BELOW 13'.
12	GREENISH GRAY SILTY FINE SAND, ZONES OF DARK GRAY CLAYEY SILT, MOIST TO SATURATED (FILL)						
13							

090280

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Form TS-GT-2-1

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. S-84
Project Name WESTLAKE	Page 2 of 3
Project No. 84-075-4-002	Date 8-24-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
15					15.0		
16	GREENISH GRAY SILTY FINE SAND, ZONES OF DARK GRAY CLAYEY SILT, MOIST TO SATURATED (FILL)			24"/24"		ST-2	Q_p = N.A.
17					17.0		
18							
19							
20							ALL MATERIAL SATURATED BELOW APPROX. 20'.
21							
22	— — — — — — —						
23	GRAY-BROWN FINE TO MEDIUM SAND, TRACE SILT, MEDIUM DENSE						
24							
25					25.0		
26			9/9/12	18"/18"		SS-3	
27					26.5		
28	— — — — — — —						APPROX. 6 FT. OF SLOUGH IN HOLE WHEN SAMPLE SS-4 WAS FIRST ATTEMPTED.
29	GRAY MEDIUM TO COARSE SAND, MEDIUM DENSITY, SATURATED						CASING WAS DRIVEN TO 30' THEN SLOUGH WASH-BORED OUT W/ TRICONE BIT.
30			5/6/9	12"/18"	30.0	SS-4	NO BENTONITE WAS USED.

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. 5-84
Project Name WESTLAKE	Page 3 of 3
Project No. 84-075-4-002	Date 8-24-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	(SEE ABOVE)				31.5	SS-4	
32	TOTAL DEPTH 31.5'						
33							A 2" d.a. PVC piezometer was installed to 30.9'.
34							
35							PVC is flush-jointed, threaded couplings. Bottom 10' is .010" machine slotted screen.
36							Gravel pack 31.5' to 20.0' with a 1.8' thick bentonite pellet seal above.
37							
38							Anulas is grouted from seal to ground surface.
39							T.O.P. is 4.0 above ground surface.
40							
							WATER LEVEL IMMEDIATELY AFTER PIEZOMETER INSTALLATION IS 23.7' BELOW T.O.P. 12:20pm 8-24-84.
							WATER LEVEL IS 23.91' BELOW T.O.P. 7:15am 8-27-84

Drilling Log

Project Name	WESTLAKE	Boring No.	D-85
Project No.	84-075-4-002	Page	1 of 6
Ground Elevation	453.1	Location	N. 340.5414, E. 1986.8430
Total Footage	84.1'		

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
SEE REMARKS	SEE REMARKS	83.5	0.6	12	0	SEE REMARKS	—

Drilling Co.	WABASH DRILLING CO.	Driller (s)	DORL THORNTON
Drilling Rig.	ACKER MP-5, TRUCK	Type of Penetration Test	STANDARD
Date	8-21-84 To 8-22-84	Field Observer (s)	GLEN ERNSTMANN

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
0–3.5	LIGHT BROWN SAND, SILT AND GRAVEL, DAMP TO DRY (FILL)						5" SOLID AUGERS 0' TO 10'
3.5–13	GREENISH-GRAY TO DARK GRAY SILTY FINE SAND, VERY LOOSE, DAMP (FILL)						
			3/2/3	7"/18"	5.0–6.5	SS-1	
			1/1/1	18"/18"	10.0–11.5	SS-2	4½" TRI-CONE WASH BORE 10.0' TO 84.1'. STOPPED 8-21-84 RESUMED 8-22-84
13–	GRAY CLAYEY SILT, AND FINE SAND, LOW PLASTICITY, STIFF, MOIST (FILL)						

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-85
Project Name WESTLAKE	Page 2 of 6
Project No. 84-075-4-002	Date 8-21-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
15	GRAY CLAYEY SILT, AND FINE SAND, LOW PLASTICITY, STIFF, MOIST (FILL)		3/4/5	12"/18"	15.0 – 16.5	SS-3	
16							
17							
18							
19							
20			2/4/4	10"/18"	20.0 – 21.5	SS-4	
21							
22	GRAY-BROWN SILTY FINE SAND, MOIST TO SATURATED						SATURATED MATERIAL ENCOUNTERED BETWEEN 18' AND 25'.
23							
24							
25				17"/18"	25.0 – 26.5	ST-5	Q_p = NOT OBTAINABLE
26							
27	GRAY FINE TO COARSE SAND, TRACE SILT, MEDIUM DENSE TO VERY DENSE, SATURATED						
28	PRIMARILY SUBROUNDED QUARTZ GRAINS						
29							
30			10/10/10	10"/18"	30.0	SS-6	

Drilling Log, continued

	Boring No. D-85
Project Name WESTLAKE	Page 3 of 6
Project No. 84-075-4-002	Date 8-21-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	GRAY FINE TO COARSE SAND, TRACE SILT, MEDIUM DENSE TO VERY DENSE, SATURATED				31.5	SS-6	
32							
33	PRIMARILY SUBROUNDED QUARTZ GRAINS						
34							
35					35.0		
36			21/27/26	13"/18"		SS-7	
					36.5		
37							
38							
39							
40	GRAY TO GRAY-BROWN COARSE SAND, SOME FINE TO MEDIUM SAND, FEW FINE GRAVELLY SEAMS, DENSE, SATURATED				40.0		
41			16/23/21	8"/18"		SS-8	
					41.5		
42							
43							
44							
45							
46							
47							

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-85
Project Name WESTLAKE	Page 4 of 6
Project No. 84-075-4-002	Date 8-21-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
49	GRAY TO GRAY-BROWN COARSE SAND, SOME FINE TO MEDIUM SAND, FEW FINE GRAVELLY SEAMS, DENSE, SATURATED						
50	GREENISH GRAY TO GRAY FINE TO MEDIUM SAND, TRACE SILT AND COARSE SAND, VERY DENSE TO DENSE, SATURATED				50.0		
51	90% QUARTZ, SUBROUNDED TO SUBANGULAR		26/34/24	13"/18"		SS-9	
					51.5		
52							
53							
54							
55							
56							
57							
58							
59							
60					60.0		
61			14/16/22	8"/18"		SS-10	
					61.5		
62							
63							
64							

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-85
Project Name WESTLAKE	Page 5 of 6
Project No. 84-075-4-002	Date 8-21-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
66	GREENISH GRAY TO GRAY FINE TO MEDIUM SAND, TRACE SILT AND COARSE SAND, VERY DENSE TO DENSE, SATURATED						
67	90% QUARTZ, SUBROUNDED TO SUBANGULAR						
68							
69							
70					70.0		
71			17/20/27	15"/18"		SS-11	
					71.5		
72							
73							
74							
75							
76							
77							
78							
79							
80					80.0		
81			17/21/34	15"/18"		SS-12	VERY SLIGHT LEACHATE LIKE OR ORGANIC ODOR
					81.5		

Drilling Log (continued)

	Boring No. D-85
Project Name WESTLAKE	Page 6 of 6
Project No. 84-075-4-002	Date 8-21-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	GRAVEL, COBBLES AND SAND, SATURATED						
83							
	CREAM TO LIGHT BROWN LIMESTONE						A 2" dia. PVC piezometer was installed to 82'.
84							
	TOTAL DEPTH 84.1'						PVC is flush-jointed, threaded couplings.
85							
86							Bottom 20' is .010" machine slotted screen.
87							Gravel pack from 84.1' to 59.7' with a 2.2' thick bentonite pellet seal above.
88							
89							Anulus is grouted from seal to ground surface.
90							T.O.P. is 3.0' above ground surface.
							WATER LEVEL IMMEDIATELY AFTER PIEZOMETER INSTALLATION 20.05' BELOW T.O.P. 10:00am 8-24-84
							WATER LEVEL IS 24.09' BELOW T.O.P. 7:15am 8-27-84.

Drilling Log

Project Name	WESTLAKE	Boring No.	D - 87
Project No.	84-075-4-002	Page	1 of 7
Ground Elevation: 460.0	Location: N 114.45, E. 903.6487	Total Footage	111.7

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
SEE REMARKS	5" @ THE SURFACE	111.0	0.7	22	0	SEE REMARKS	—

Drilling Co.	WABASH DRILLING CO.	Driller (s)	DORL THORNTON
Drilling Rig.	ACKER MP-5, TRUCK	Type of Penetration Test	STANDARD
Date 8-9-84	To 8-10-84	Field Observer (s)	GLEN ERNSTMANN

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
0–1	LIGHT BROWN FINE TO COARSE SAND, SOME SILT AND GRAVEL, DAMP (FILL)						5" SOLID AUGERS 0' TO 30.0'
1–5.8	LIGHT GRAY GRAVEL (2" MAX. DIA.), SOME SAND, VERY DENSE, DAMP (FILL)						
5		—	50/3"	2"/3"	5.0 / 5.3	SS-1	
5.8–	MOTTLED LIGHT GRAY TO DARK GRAY TO BROWN SANDY SILTY CLAY, MEDIUM PLASTICITY, STIFF, MOIST (FILL TRACE GRAVEL (2" MAX. DIA.)						
10			2/3/4	12"/18"	10.0 / 11.5	SS-2	

Drilling Log, continued

	Boring No. D-87
Project Name WESTLAKE	Page 2 of 7
Project No. 84-075-4-002	Date 8-9-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
15	MOTTLED LIGHT GRAY TO DARK GRAY TO BROWN SANDY, SILTY CLAY, MEDIUM PLASTICITY, STIFF MOIST (FILL				15.0		
16	TRACE GRAVEL (2" MAX. DIA.)			23"/24"		ST-3	Q_p = 1.5 TSF
17					17.0		
18							
19	— — — — — —						
20	DARK GRAY SILTY CLAY, MEDIUM TO HIGH PLASTICITY, VERY STIFF, MOIST				20.0		
21				21"/24"		ST-4	Q_p = 2.75 TSF
22					22.0		
23	— — — — — —						
24	DARK GRAY SANDY SILT AND SILTY SAND INTERBEDS, SAND IS FINE TO MEDIUM, LOW TO NON-PLASTIC, WET TO SATURATED						
25					25.0		
26				4"/24"		ST-5	Q_p = N.A.
27					27.0		SATURATED MATERIAL FIRST ENCOUNTERED @ APPROXIMATELY 27.0' BELOW G.S.
28							
29	— — — — — —						
30	BROWN TO GRAY-BROWN SILTY FINE SAND, MEDIUM DENSE SATURATED, SLIGHTLY MICACEOUS		3/7/8	10"/18"	30.0	SS-6	

Drilling Log, continued

	Boring No. D-87
Project Name WEST LAKE	Page 3 of 7
Project No. 84-075-4-002	Date 8-9-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
32	BROWN TO GRAY-BROWN SILTY FINE SAND, MEDIUM DENSE SATURATED SLIGHTLY MICACEOUS				31.5	SS-6	NOTE: HOLE COLLAPSED TO 26.7' AFTER SAMPLE SS-6 WAS OBTAINED. NO FREE WATER OCCURS ABOVE THIS DEPTH.
33							
34	— — — — — — —						BEGAN ROTARY WASH BORING W/ 4½" DIA. TRI-CONE BIT @ 30.0'
35	BROWN FINE TO MEDIUM SAND, TRACE SILT, ~~A~~ HIGHLY QUARTZOSE, DENSE, SATURATED		12/14/20	4"/18"	35.0	SS-7	
36					36.5		
37	— — — — — — — —						
38	LIGHT BROWN FINE TO COARSE SAND INTERBEDDED WITH THIN (3" TO 10" THICK) GRAVEL SEAMS, TRACE SILT, DENSE TO VERY DENSE, SATURATED						
39							
40			15/25/25	8"/18"	40.0	SS-8	
41					41.5		
42							
43							
44							
45			17/23/14	8"/18"	45.0	SS-9	
46					46.5		
47							

Drilling Log, continued

	Boring No. D-87
Project Name WESTLAKE	Page 4 of 7
Project No. 84-075-4-002	Date 8-9-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
49	LIGHT BROWN FINE TO COARSE SAND INTERBEDDED WITH THIN (3" TO 10" THICK) GRAVEL SEAMS, TRACE SILT, DENSE TO VERY DENSE, SATURATED						
50			14/24/50	10"/18"	50.0	SS-10	
51					51.5		
52	DARK GREENISH GRAY FINE TO MEDIUM SAND, TRACE SILT, DENSE TO VERY DENSE, SATURATED						
53							
54							
55			12/17/23	9"/18"	55.0	SS-11	
56					56.5		
57							
58							
59							
60			33/35/50/4"	12"/18"	60.0	SS-12	
61					61.5		
62							
63							
64							

Drilling Log, continued

	Boring No. D-87
Project Name WESTLAKE	Page 5 of 7
Project No. 84-075-4-002	Date 8-9-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	DARK GREENISH GRAY FINE TO MEDIUM SAND, TRACE SILT, DENSE TO VERY DENSE, SATURATED		24/25/36	13"/18"	65.0	SS-13	
66							
					66.5		STOPPED 8-9-84 RESUMED 8-10-84
67							
68							
69							
70			30/23/24	14"/18"	70.0	SS-14	
71					71.5		
72							
73							
74							
75	GRAY TO DARK GREENISH GRAY FINE TO COARSE SAND, HIGHLY QUARTZOSE, SUBROUNDED GRAINS, VERY DENSE TO MEDIUM DENSE, SATURATED FEW THIN (3" TO 6") GRAVEL SEAMS		22/29/34	14"/18"	75.0	SS-15	
76					76.5		
77							
78							
79							
80			27/37/26	11"/18"	80.0	SS-16	
81					81.5		

Drilling Log, continued

	Boring No. D-87
Project Name WESTLAKE	Page 6 of 7
Project No. 84-075-4-002	Date 8-9-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
83–84	GRAY TO DARK GREENISH GRAY FINE TO COARSE SAND, HIGHLY QUARTZOSE, SUBROUNDED GRAINS, VERY DENSE TO MEDIUM DENSE, SATURATED						
85–86	FEW THIN (3" TO 6" THICK) GRAVEL SEAMS AT INTERVALS OF 1' TO 5'.		15/16/14	9"/18"	85.0–86.5	SS-17	
88–89	NOTE: SAND IS PREDOMINANTLY COARSE WITH TRACE FINE GRAVEL THROUGHOUT BELOW APPROXIMATELY 88'.						
90–91			15/17/22	8"/18"	90.0–91.5	SS-18	
95–96			14/15/18	7"/18"	95.0–96.5	SS-19	

Drilling Log, continued

	Boring No. D-87
Project Name WESTLAKE	Page 7 of 7
Project No. 84-075-4-002	Date 8-9-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
100	GRAY TO DARK GREENISH GRAY FINE TO COARSE SAND, HIGHLY QUARTZOSE SUBROUNDED GRAINS, VERY DENSE TO MEDIUM DENSE, SATURATED		24/50/6"	6"/12"	100.0 – 101.0	SS-20	
101–104	FEW THIN (3" TO 6" THICK) GRAVEL SEAMS AT INTERVALS OF ROUGHLY 1' TO 5'. NOTE: SAND IS PREDOMINANTLY COARSE WITH TRACE FINE GRAVEL THROUGHOUT BELOW APPROXIMATELY 88'.						A 2" dia. PVC piezometer was installed to 111'. PVC is flush-joint, threaded couplings. Bottom 20' is .010" machine slotted screen. Bottom 24' is gravel packed with a 3' thick bentonite pellet seal above. Anulus is grouted from seal to ground surface. T.O.P. is 3' above ground surface.
105			24/31/48	9"/18"	105.0 – 106.5	SS-21	
110			17/30/50/4"	10"/16"	110.0 – 111.3	SS-22a / SS-22b	
111	GRAY TO CREAM LIMESTONE, MEDIUM STRONG TO STRONG, SLIGHTLY TO MODERATELY WEATHERED						111.7'
112–113	TOTAL DEPTH 111.7'						WATER LEVEL IMMEDIATELY AFTER PIEZOMETER INSTALLATION 8-10-84 IS 4.46 BELOW T.O.P.
114–115							WATER LEVEL @ 26.05' BELOW T.O.P. 8:15am 8-14-84

Drilling Log

Project Name				Boring No.
WESTLAKE				S-88

Project No.	Page	of
84-075-4-002	1	3

Ground Elevation	Location	Total Footage
460.0	N. 695.0461, E. 309.2279	41.5

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
SEE REMARKS	SEE REMARKS	41.5'	0	7	0	SEE REMARKS	-

Drilling Co.	WABASH DRILLING CO.	Driller (s)	DORL THORNTON
Drilling Rig.	ACKER MP-5, TRUCK	Type of Penetration Test	STANDARD
Date	8-15-84 To 8-16-84	Field Observer (s)	GLEN ERNSTMANN

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
1	GRAY TO BROWN SAND AND FINE GRAVEL, DRY TO DAMP (FILL)						5" DIA. SOLID AUGERS 0' TO 30'.
2							
3							
4							
5	GRAVEL, SOME SAND, DAMP (FILL)						
6							
7	BROWN SILT, LOW TO NON-PLASTIC, MOIST TO DAMP (FILL)						
8	GRAVEL (1" MAX. DIA.), SOME SAND, CLAY AND LANDFILL DEBRIS, DAMP (FILL)						
9							
10					10.0		
11			6/14/16	15"/18"		SS-1	
					11.5		
12							
13							

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. S-88
Project Name WESTLAKE	Page 2 of 3
Project No. 84-075-4-002	Date 8-15-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
15	GRAY FINE SANDY SILT, LOW PLASTICITY, MEDIUM DENSE, DAMP		3/4/8	17" / 18"	15.0 – 16.5	SS-2	
17							SATURATED SEAMS FIRST ENCOUNTERED @ APPROX. 18'.
18	FEW THIN, SATURATED SILTY FINE TO COARSE SAND SEAMS 18' TO 24'.						
20			5/4/10	18" / 18"	20.0 – 21.5	SS-3	
22							MATERIAL IS SATURATED BELOW APPROX. 24'
24	GRAY SILTY FINE TO MEDIUM SAND, FEW SANDY SILT SEAMS, SATURATED						
25			*4/3/4	0" / 24"	25.0 – 27.0	ST-4	Q_p = N.A. NO RECOVERY ON THE SHELBY TUBE *A SPLIT SPOON SAMPLE WAS OBTAINED 25.0' TO 26.5'
28.5	GRAY FINE TO MEDIUM SAND, TRACE SILT, LOOSE TO VERY DENSE, SATURATED						4½" DIA. TRI-CONE WASH BORE 30' TO 41.5'
30			3/3/5	18 / 18"	30.0	SS-5	

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. S-88
Project Name WESTLAKE	Page 3 of 3
Project No. 84-075-4-002	Date 8-15-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
32	GRAY FINE TO MEDIUM SAND, QUARTZOSE, TRACE SILT, LOOSE TO VERY DENSE, SATURATED				31.5	SS-5	STOPPED 8-15-84 RESUMED 8-16-84
33							
34	NOTE: COLOR OF SAND IS BROWN 34' TO 37'.						
35					35.0		
36	FEW THIN COARSE SAND SEAMS 37' TO 41.5'.		11/20/50 5½	12"/17½"	36.5	SS-6	
37							
38							
39							A 2" dia. PVC piezometer was installed to 40'. PVC is flush-joint, threaded couplings.
40					40.0		Bottom 10' is .010" machine slotted screen.
41			13/20/33	10"/18"	41.5	SS-7	Bottom 11' is gravel packed with a 2' thick bentonite pellet seal above.
42	TOTAL DEPTH 41.5'						Anulus is pressure grouted from seal to ground surface. T.O.P. IS 2.7' ABOVE GROUND SURFACE
43							
44							
45							WATER LEVEL IS @ 29.3' BELOW T.O.P. IMMEDIATELY AFTER PIEZOMETER INSTALLATION, 11:00 8-16-84.
46							
47							

Drilling Log

Project Name WESTLAKE						Boring No D-89	
Project No. 84-075-4-002						Page 1 of 4	
Ground Elevation 454.1		Location N. 1790.5514, E. 602.6094				Total Footage 49.0'	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
SEE REMARKS	SEE REMARKS	47.8	1.2'	8	0	SEE REMARKS	—
Drilling Co. WABASH DRILLING CO.				Driller (s) DORL THORNTON			
Drilling Rig. ACKER MP-5, TRUCK				Type of Penetration Test STANDARD			
Date 8-27-84	To 8-28-84			Field Observer (s) GLEN ERNSTMANN			

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
1	LIGHT GRAY TO GRAY TO BROWN SAND AND GRAVEL, SOME SILT, DAMP (FILL)						5" SOLID AUGERS 0' TO 25'.
2							
3							
4							
5							
6							
7	GREENISH BROWN TO DARK GRAY SILTY CLAY AND CLAYEY SILT, LOW TO MEDIUM PLASTICITY, STIFF, DAMP TO MOIST (FILL)						
8							
9							
10	NOTE: COLOR IS GREENISH BROWN WITH SOME BROWN (IRON) STAINS BELOW APPROX. 14'		3/2/3	15"/18"	10.0–11.5	SS-1	
11							
12							
13							

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-89
Project Name WESTLAKE	Page 2 of 4
Project No. 84-075-4-002	Date 8-27-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	GREENISH BROWN TO DARK GRAY SILTY CLAY AND CLAYEY SILT, LOW TO MEDIUM PLASTICITY, DAMP TO MOIST, STIFF						
15					15.0		
16				18" / 24"		ST-2	Q_p = 1.75 TSF
	NOTE: COLOR IS GREENISH BROWN WITH SOME BROWN (IRON) STAINS BELOW APPROX. 14'.						
17					17.0		
18							FEW THIN SATURATED ZONES 15' TO 20'.
19							MATERIAL IS SATURATED BELOW APPROX. 21'.
20					20.0		
21				24" / 24"		ST-3	Q_p = 1.0 TSF
22					22.0		STOPPED 8-27-84 RESUMED 8-28-84 NOTE: WATER LEVEL IS 19.3' BELOW G.S. 7:00 am 8-28-84
23	GRAY SILTY FINE TO MEDIUM SAND, SATURATED						
24	GRAYISH SILTY CLAY, MEDIUM PLASTICITY, SATURATED						
25					25.0		
26	GRAY SILTY FINE TO MEDIUM SAND, MEDIUM DENSE, SATURATED			* 12" / 24"		ST-4	Q_p = N.A.
							* Approx. 12" of material was retained in the tube but it slipped out of the tube and was lost when brought to the surface. A Jar sample was collected.
27					27.0		
28							
29							$4\frac{1}{2}$" TRI-CONE WASH-BORE; 25' TO
30					30.0		
			10/12/18	18" / 18"		SS-5	

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-89
Project Name WESTLAKE	Page 3 of 4
Project No. 84-075-4-002	Date 8-27-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
						SS-5	
					31.5		
32	GRAY SILTY FINE TO MEDIUM SAND, MEDIUM DENSE, SATURATED						
33							
34	GRAY FINE TO MEDIUM SAND, DENSE, SATURATED						
35							
					35.0		
36	90% TO 95% SUBANGULAR QUARTZ GRAINS		7/14/28	16"/18"		SS-6	
					36.5		
37							
38							
39	GRAY TO BROWN FINE TO MEDIUM SAND WELL SORTED, DENSE TO VERY DENSE, SATURATED						
40					40.0		
41	80% QUARTZ, 10% CHERT FRAGMENTS, QUARTZ GRAINS ARE SUBROUNDED TO ROUNDED		7/11/23	11"/18"		SS-7	
					41.5		
42							
43							
44							
45					45.0		
46			13/18/39	10"/18"		SS-8	
					46.5		
47							
	BUFF LIMESTONE						

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-89
Project Name WESTLAKE	Page 4 of 4
Project No. 84-075-4-002	Date 8-27-84

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	BUFF LIMESTONE						
49							
	TOTAL DEPTH 49.0'						
50							
51							A 2" dia. PVC piezometer was installed to 49'. PVC is flush-jointed, threaded couplings.
52							
53							Bottom 15' is .010" machine slotted screen.
54							Bottom 16.5' is gravel packed with a 2' thick bentonite pellet seal above.
55							Annulus is pressure grouted from seal to surface.
							T.O.P. is 3' above ground surface.
							WATER LEVEL IS 22.3' BELOW T.O.P. IMMEDIATELY AFTER PIEZOMETER INSTALLATION, 1:30pm 8-28-84

Drilling Log

Project Name	Boring No.
WESTLAKE	D-90

Project No.	Page	of
84-075-4-004	1	1

Ground Elevation	Location	Total Footage
See Exhibit I-1	See Exhibit I-1	47

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
Solid 4" Auger & Rotary Wash	4" & 3 7/8"	46	1			9'	8/7/85

Drilling Co. WABASH (Subsurface Construction Company)

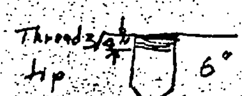
Driller (s) Gary Miles, Gary Feldmann

Drilling Rig. CME-750

Type of Penetration Test SPT

Date Aug 6, 1985 To Aug 7, 1985

Field Observer (s) Stathis Payiatakis

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
	sl. sandy silt - tan & brown, damp						10:10 Start drilling w/ 4" solid auger
5	Br. Grey mottled sl. silty clay, damp, med. plastic		3/5/5	18/18		SPT-1	→ switch to rotary wash w/ 3 7/8 tricone rotary bit.
10	Br. silty fine sand, loose		2/3/4	12/18		SPT-2	
15	Br sl. silty fine sand, mdm dense		5/7/7	12/18		SPT-3	
20	Same as above		3/6/7	10/18		SPT-4	
25	Br. sl. silty fine to medium sand, dense.		9/16/18	19/18		SPT-5	
30	Tan brown mdm to coarse sand, md. dense		15/15/12	4/18		SPT-6	
35	Dk Grey silty v. fine sand, loose		5/3/3	12/18		SPT-7	
40	Dk. Grey silty clay, moist, ~~soft~~ weak, plastic		0/0/1	18/18		SPT-8	Settled 12" under weight of 40' rods. Stop for the day - Heavy rainstorm
45	Dk Grey sl. silty fine sand, dense Limestone, lt brown, very hard; sl. weathered → 1.5" seam - Loose water pressure		19/50-5.5"	11.5/11.5		SPT-9	8/7/85 Start again @ 40'.
	BOB @ 46.9'						Rock @ 46.
50	Total pipe length 50'-5 1/4" Piezometer @ ~ 46'-3 1/4" depth below G.S.						Rate @ 500psi w/ tricone 5 min for 2" 30 min for 10"
55							8:45 Start piezometer installation
60	Piezometer tip 						9:30 Grout w/ pipe @ 2 9:50 Remove top casing
65							
70							

Burns & McDonnell ENGINEERS · ARCHITECTS · CONSULTANTS

Form TS-GT-21

Drilling Log

Project Name: WESTLAKE	Boring No.: D-91
Project No.: 84-075-4-004	Page 1 of 1
Ground Elevation ≈448 See Exhibit I-1 / Location: See Exhibit I-1	Total Footage: 45

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
SEE REMARKS	SEE REMARKS	44'	1'	4	0	9.25' from G.S.	7:45 8/6/85

Drilling Co. WABASH	Driller (s) Gary Miles, Gary Feldmann
Drilling Rig. CME-750	Type of Penetration Test: SPT
Date Aug 5, 1985 To Aug 6, 1985	Field Observer (s) Stathis Payiatacis

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
0	Topsoil, organic Lt br. f. sandy silt, sl. plastic, v. loose, damp						Start drilling @ 11:00 w/ 4" solid augers. Push 4 5/8" OD 4" ID casing & set water tank. Tricone bit 3 7/3" ⌀
5–10	Gr. brn silty clay, mod. plastic						
15	Gr. brn f. sandy silt, some clay						
20	Gr. silty clay, mod. plastic, tr. sand						
25	Gr. sl. silty clay, mod. plastic, soft, moist becomes more silty near 30'		0*/1/1	18/18		SPT-1	*Sank 6" under weight of 25' rod.
30	Dk. grey v.f. sand, loose, saturated, tr. silt		1/2/2	18/18		SPT-2	
35			3/2/3	10/18		SPT-3	
40	Tan-grey f. to med. sand, med. dense, w/ thin (2"-4") clay lenses		3/9/11	9/18		SPT-4	
45	Limestone, white/creamy, mod. strong, mod. hard, sl. weathered BOB						14:00 Finish drilling 14:10 Start piezometer installation. 10' screen + 40' 2" "Triloc" PVC pipe, flush threaded schedule 50 & scl. 20 screen (200 slots/inch) SL-500 15:15 Finish for day 8/6/85. Grout to surface. Finish @ 9:00
50–70							

Bentonite Pellets … (left margin notes: sand, screen)

090280 Burns & McDonnell ENGINEERS - ARCHITECTS - CONSULTANTS Form TS-GT-2-1

Drilling Log

Project Name	WESTLAKE	Boring No.	D - 92
Project No.	84-075-4-004	Page 1 of 9	
Ground Elevation 475.37	Location See Exhibit I-1	Total Footage	143.6

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
SEE REMARKS	4 7/8"	143.6	0.0	19	0	SEE REMARKS	—

Drilling Co.	SUBSURFACE CONSTRUCTORS (WABASH)	Driller (s)	DORL THORNTON, DEAN
Drilling Rig.	ACKER MP-5, TRUCK	Type of Penetration Test	STANDARD
Date 4-9-85	To 4-11-85	Field Observer (s)	G. ERNSTMANN

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
1	LIGHT GRAY-BROWN SAND AND GRAVEL (3" MAX. DIA.).						4" SOLID AUGERS 0' TO 40.0'
2	— — — — — —						
3	GRAY AND BROWN GRAVELLY SAND, SOME SILT, LOOSE TO MEDIUM DENSE, MOIST (FILL)						
4	SLIGHT LEACHATE-LIKE ODOR						
5					5.0		
6			5/6/6	9"/18"		SS-1	
7					6.5		
8							
9							
10					10.0		
11			2/3/3	7"/18"		SS-2	
12	— — — — — —				11.5		
13	BROWN SANDY SILT, LOW PLASTICITY, TRACE GRAVEL, LOOSE (FILL)						

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-92
Project Name WESTLAKE	Page 2 of 9
Project No. 84-075-4-004	Date 4-9-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
15	BROWN SANDY SILT, LOW PLASTICITY, TRACE GRAVEL, LOOSE TO MEDIUM DENSE, MOIST (FILL)				15.0		
16			3/5/5	6"/18"		SS-3	
					16.5		
17							
18							
19							
20					20.0		
21			3/5/6	8"/18"		SS-4	
					21.5		
22							
23							
24							
25					25.0		
26			6/5/5	11"/18"		SS-5	
					26.5		
27							
28							
29							
30					30.0		
			5/6/7	15"/18"		SS-6	

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-92
Project Name WESTLAKE	Page 3 of 9
Project No. 84-075-4-004	Date 4-9-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	BROWN SANDY SILT, LOW PLASTICITY, TRACE GRAVEL, LOOSE TO MEDIUM DENSE, MOIST				31.5	SS-6	
32							
33	DARK GRAY SILTY CLAY, MEDIUM PLASTISITY, VERY STIFF, MOIST						
34	SLIGHT LEACHATE-LIKE ODOR						
35			5/7/13	16"/18"	35.0		
36					36.5	SS-7	
37							
38	GRAY FINE TO MEDIUM SAND, MOIST						
39							SATURATED MATERIAL ENCOUNTERED @ APPROX. 39.5'
40	GRAY SILTY FINE TO MEDIUM SAND, MEDIUM DENSE, SATURATED		8/11/7	11"/18"	40.0		
41					41.5	SS-8	STOPPED 4-9-85 RESUMED 4-10-85
42							BEGAN WASH BORING w/ 3 7/8" TRI-CONE BIT AND BENTONITE MUD @ 40.0'.
43							
44	GRAY FINE TO MEDIUM SAND, TRACE SILT, DENSE, SATURATED						
45			10/17/17	15"/18"	45.0		
46					46.5	SS-9	
47							

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-92
Project Name WESTLAKE	Page 4 of 9
Project No. 84-075-4-004	Date 4-9-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	GRAY FINE TO MEDIUM SAND, TRACE SILT, DENSE, SATURATED						
49	— — — — — — —						
	BROWN FINE TO COARSE SAND, VERY DENSE, SATURATED						
50					50.0		
51			20/28/26	11"/18"		SS-10	
					51.5		
52							
53							
54							
55							
56							
57							
58							
59							
60					60.0		
61			16/26/34	10"/18"		SS-11	
					61.5		
62							
63							
64							

Drilling Log (continued)

	Boring No. D-92
Project Name WESTLAKE	Page 5 of 9
Project No. 84-075-4-004	Date 4-9-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	BROWN FINE TO COARSE SAND, VERY DENSE, SATURATED						
66							
67	— — — — — — —						
68	GRAY MEDIUM TO COARSE SAND, VERY DENSE, SATURATED						
69							
70			21/34/36	15"/18"	70.0	SS-12	
71					71.5		
72							
73							
74							
75	— — — — — —						
76	GRAY-BROWN COARSE SAND, SOME MEDIUM TO FINE SAND, MEDIUM DENSE TO VERY DENSE, SATURATED						
77							
78							
79							
80			15/11/13	7"/18"	80.0	SS-13	
81					81.5		

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-92
Project Name WESTLAKE	Page 6 of 9
Project No. 84-075-4-004	Date 4-9-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
83	GRAY-BROWN COARSE SAND, SOME MEDIUM TO FINE SAND, MEDIUM DENSE TO VERY DENSE, SATURATED						
84							
85							
86							
87							
88							
89	GRAY FINE TO MEDIUM SAND, TRACE SILT, VERY DENSE, SATURATED						
90					90.0		
91	GRAY SILTY FINE SAND, VERY DENSE, SATURATED		25/28/39	9"/18"		SS-14	
					91.5		
92							
93							
94	GRAY-BROWN COARSE SAND, SOME MEDIUM TO FINE SAND, DENSE						
95							
96							
97							
98							

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-92
Project Name WESTLAKE	Page 7 of 9
Project No. 84-075-4-004	Date 4-9-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
100	GRAY-BROWN COARSE SAND, SOME MEDIUM TO FINE SAND, DENSE				100.0		
101			17/22/26	8"/18"		SS-15	
					101.5		
102							
103							
104							
105							
106							
107	— — — — — — —						
108	BROWN-GRAY COARSE SAND, TRACE MEDIUM SAND AND FINE GRAVEL, VERY DENSE, SATURATED						
109							
110					110.0		
111			31/50/6"	8"/12"	111.0	SS-16	STOPPED 4-10-85 RESUMED 4-11-85
112	— — — — — — —						
113	GRAY-BROWN MEDIUM TO COARSE SAND WITH THIN (1" TO 3" THICK) GRAVEL INTERBEDS, SATURATED						
114							
115							

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-92
Project Name WESTLAKE	Page 8 of 9
Project No. 84-075-4-004	Date 4-9-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
117	GRAY-BROWN MEDIUM TO COARSE SAND WITH THIN (1" TO 3" THICK) GRAVEL INTERBEDS, SATURATED						
118							
119	GRAY MEDIUM TO COARSE SAND, TRACE SILT, VERY DENSE, SATURATED						
120					120.0		
121			17/24/28	8"/18"		SS-17	
					121.5		
122							
123	GRAVEL SEAM 123.0' TO 123.3'						
124							
125							
126							
127							
128							
129							
130					130.0		
131			20/19/31	6"/18"		SS-18	
					131.5		
132							

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-92
Project Name WESTLAKE	Page 9 of 9
Project No. 84-075-4-004	Date 4-9-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
134	GRAY MEDIUM TO COARSE SAND, TRACE SILT, VERY DENSE, SATURATED						HOLE WAS REAMED W/ A 4 7/8" TRI-CONE BIT.
135							
136							4½" O.D. steel casing was temporarily installed to 143.6'.
137							
138							The bentonite mud was flushed from the casing w/ potable water.
139							A 2" dia. PVC piezometer was installed to 143'. Flush-joint, threaded couplings.
140			21/36/50/4"	9"/16"	140.0	SS-19	
141					141.3		Bottom 20' is .010 machine-slotted screen.
142							Gravel pack w/ quartz sand to 120.0'.
143							Bentonite pellets 120.0' to 117.5'.
144	LIMESTONE						143.6
	TOTAL DEPTH 143.6						HOLE COLLAPSED ABOVE THE BENTONITE SEAL TO 40' BELOW G.S.
145							GROUT 0' TO 40'.
146							WATER LEVEL IN PIEZOMETER IMMEDIATELY AFTER INSTALLATION 59.6' BELOW G.S. 10:00am 4-15-85.
147							
148							T.O.P. IS 0.2' BELOW G.S.
149							4-17-85 11:15am 38.9' BELOW T.O.P.

Drilling Log

Project Name	WESTLAKE	Boring No.	D-93
Project No.	84-075-4-004	Page	1 of 8
Ground Elevation	450.70	Location	
Total Footage	169.2		

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
WASH BORE	4 7/8"	118.0	1.2	16	0	SEE REMARKS	—

Drilling Co.	SUBSURFACE CONSTRUCTION (WABASH)	Driller (s)	GARY MILES
Drilling Rig.	CME 750, ATV	Type of Penetration Test	STANDARD
Date	4-15-85 To 4-18-85	Field Observer (s)	GLEN ERNSTMANN

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
1	GRAY TO BROWN SILTY CLAY, AND SAND, SOME GRAVEL AND FEW BOULDERS, MOIST (FILL)						6" H.S. AUGER 0.0' TO 3.0'. 6" CASING SET TO 8'. 4 7/8" TRI-CONE WASH BORE 8.0' TO BENTONITE DRILLING MUD.
2							
3							
4							
5					5.0		
6			2/3/5	7"/18"		SS-1	
					6.5		
7							
8							STOPPED 4-15-85 RESUMED 4-16-85
9							
10					10.0		
11			5/3/4	0"/18"		SS-2	NO RECOVERY (PROBABLY A PIECE OF GRAVEL IN THE SPOON TIP)
					11.5		
12							
13							

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

Boring No.	B-93
Project Name	WESTLAKE
Page	2 of 8
Project No.	84-075-4-004
Date	4-15-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	GREENISH BROWN FINE SAND,						
15	SOME MEDIUM SAND, MEDIUM DENSE, MOIST, TRACE SILT		5/8/9	8"/18"	15.0		
16						SS-3	
					16.5		
17							
18							
19							
	BROWN MEDIUM SAND, SOME FINE SAND, MEDIUM DENSE,						
20	SATURATED						
			9/10/11	8"/18"			
21						SS-4	
22							
23	BROWN COARSE SAND SEAM 22.0-22.4						
24	BROWN MEDIUM TO COARSE SAND, MEDIUM DENSE, SATURATED						
25					25.0		
			6/9/12	9"/18"		SS-5	
26					26.5		
27	SEVERAL COARSE SAND AND FINE GRAVEL SEAMS, 26.0 TO 30.0						
28							
29							
30					30.0		
			10/14/14	9/18"		SS-6	

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-9
Project Name WESTLAKE	Page 3 of 8
Project No. 84-675-4-004	Date 4-15-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	BROWN MEDIUM TO COARSE SAND, MEDIUM DENSE, SATURATED				31.5	SS-6	
32							
33							
34	— — — — — — —						
35	GRAY-BROWN FINE TO MEDIUM SAND, TRACE SILT, FEW THIN GRAY CLAY SEAMS, DENSE, SATURATED		9/17/18	10" / 18"	35.0	SS-7	
36					36.5		
37							
38	— — — — — — —						
39	GRAY COARSE SAND, SOME MEDIUM SAND, TRACE GRAVEL, MEDIUM DENSE, SATURATED						
40			8/13/14	8" / 18"	40.0	SS-8	5.0
41					41.5		
42							
43							
44							
45			9/14/14	9" / 18"	45.0	SS-9	5.0
46					46.5		
47							

Drilling Log (continued)

	Boring No. D-93
Project Name WESTLAKE	Page 4 of 8
Project No. 84-075-4-004	Date 4-15-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	GRAY COARSE SAND, SOME MEDIUM SAND, TRACE GRAVEL, MEDIUM DENSE, SATURATED						
49							
	GRAY SILTY FINE SAND, SOME MEDIUM SAND, VERY DENSE, SATURATED						
50					50.0		
51			18/25/26	15"/18"		SS-10	
					51.5		
52							
53							
54							
55							
56							
57							
58	FINE GRAVEL, SOME SAND AND COARSE GRAVEL, SATURATED						
59							
60	GRAY SILTY FINE SAND, SOME SILTY MEDIUM SAND SEAMS, DENSE TO VERY DENSE, SATURATED				60.0		
61			14/25/20	13"/18"		SS-11	5.0
					61.5		
62							
63							
64							

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-93
Project Name WESTLAKE	Page 5 of 8
Project No. 84-075-4-004	Date 4-15-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
66	GRAY SILTY FINE SAND, SOME SILTY MEDIUM SAND SEAMS DENSE TO VERY DENSE, SATURATED						
67							
68							
69							
70					60.0		
71			17/34/28	8"/18"		SS-12	
					61.5		
72							
73							
74							
75							
76	FINE GRAVEL AND SAND, SOME COARSE GRAVEL						
77	GRAY MEDIUM TO COARSE SAND, TRACE FINE TO COARSE GRAVEL, DENSE, SATURATED						
78							
79							
80					80.0		
81			14/25/24	14"/18"		SS-13	
					81.5		

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-93
Project Name WESTLAKE	Page 6 of 8
Project No. 84-075-4-004	Date 4-15-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
83	FINE TO COARSE GRAVEL						
84	GRAY-BROWN COARSE SAND, SOME FINE GRAVEL, DENSE, SATURATED						SLOWER DRILLING RATE AND MUCH GREATER CIRCULATION LOSS 80' TO
85	COARSE GRAVEL SEAM 85.5' TO 86.0'						
86							
87							
88							
89							
90					90.0		
91			13/16/19	9"/18"		SS-14	
					91.5		STOPPED 4-16-85 RESUMED 4-17-85
92							
93	GRAY-BROWN COARSE SAND AND FINE GRAVEL, SOME COARSE GRAVEL, FEW THIN (1" TO 12" THICK) SAND SEAMS, VERY DENSE, SATURATED						
94							
95							
96							
97							
98							

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-93
Project Name WESTLAKE	Page 7 of 8
Project No. 84-075-4-004	Date 4-15-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	GRAY-BROWN COARSE SAND AND FINE GRAVEL, SOME COARSE GRAVEL						
100	FEW SAND SEAMS (1" TO 12" THICK) VERY DENSE, SATURATED		18/24/48	8"/18"	100.0		
101						SS-15	
					101.5		
102							
103							
104							
105							
106	COBBLE 106.0' TO 106.5'						
107							
108	COARSE SAND, TRACE FINE GRAVEL						
109							
110	FINE TO COARSE GRAVEL, SOME SAND COBBLE 110.0' TO 110.4'.						
111							
112	GRAY COARSE SAND AND FINE GRAVEL, SOME COARSE GRAVEL, DENSE, SATURATED						
113							
114							
115			15/22/27	3"/18"		SS-16	STOPPED 4-17-85 RESUMED 4-18-85.

111479 | Burns & McDonnell Engineers-Architects-Consultants | Form TS-GT-2-2

Drilling Log, continued

	Boring No. D-93
Project Name WESTLAKE	Page 8 of 8
Project No. 84-075-4-004	Date 4-15-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	GRAY COARSE SAND AND FINE GRAVEL, SOME COARSE GRAVEL, DENSE, SATURATED				116.5	SS-16	
117							
118	FRACTURED LIMESTONE						4½" dia. steel casing was temporarily installed to 112'. Hole collapsed to 112'.
119	LIMESTONE						
	TOTAL DEPTH 119.2'						
120							A 2" dia. PVC, flush-joint, threaded coupling piezometer was installed to 112'.
121							
122							The casing was pulled back to 90' and the hole collapsed to 91'.
123							
124							Bentonite pellets 91' to 89.6'.
125							Grout 89.6' to surface.
126							20' of .010 machine - slotted screen. T.O.P. is 3.3' above ground surface
127							
128							Water level in piezometer immediately after installation 4-18-85 1:30pm is 15.4' below T.O.P.
129							
130							
131							
132							

Drilling Log

Project Name	Boring No.
WESTLAKE	D-94

Project No.	Page	of
84-075-4-004	1	7

Ground Elevation	Location	Total Footage
442.68		109.0

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
WASH BORE	3 7/8"	108.8	0.2	15	0	SEE REMARKS	—

Drilling Co.	SUBSURFACE CONSTRUCTORS (WABASH)	Driller (s)	GARY MILES
Drilling Rig.	CME 750, ATV	Type of Penetration Test	STANDARD
Date	4-18-85 To 4-24-85	Field Observer (s)	GLEN ERNSTMANN

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
	BROWN SANDY SILT AND ORGANIC MATERIAL, MOIST						4" solid auger 0' to 5'.
1	BROWN FINE TO MEDIUM SAND, TRACE SILT, VERY LOOSE TO VERY DENSE, SATURATED BELOW 2'.						5' of 4" casing set.
2							Wash bore w/ 3 7/8" tri-cone roller bit 5' to
3							SATURATED MATERIAL @ APPROX. 3'.
4							
5					5.0		
			1/2/3	17"/18"		SS-1	
6					6.5		STOPPED 4-18-85 RESUMED 4-19-85
7							
8							
9							
10					10.0		
			3/5/7	6"/18"		SS-2	
11					11.5		
12							
13							

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

Boring No.	D-94
Project Name	WESTLAKE
Page	2 of 7
Project No.	84-075-4-004
Date	4-18-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
15	BROWN FINE TO MEDIUM SAND, TRACE SILT, VERY LOOSE TO VERY DENSE, SATURATED		11/22/28	7"/18"	15.0 – 16.5	SS-3	
16							
17							
18							
19							
20			18/24/31	15"/18"	20.0 – 21.5	SS-4	
21							
22							
23							
24							
25			8/11/15	13"/18"	25.0 – 26.5	SS-5	
26							
27							
28	— — — — — —						
29	GRAY-BROWN FINE TO COARSE SAND, FEW COARSE SAND SEAMS (1" TO 2" THICK), MEDIUM DENSE, SATURATED						
30			12/8/7	9"/18"	30.0	SS-6	

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-94
Project Name WESTLAKE	Page 3 of 7
Project No. 84-075-4-004	Date 4-18-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	GRAY-BROWN FINE TO COARSE SAND, FEW COARSE SAND SEAMS (1" TO 2" THICK), MEDIUM DENSE, SATURATED				31.5	SS-6	
32							
33	BROWN COARSE SAND, SOME MEDIUM TO FINE SAND, MEDIUM DENSE, SATURATED						
34							
35			9/13/12	8"/18"	35.0		
36					36.5	SS-7	
37							
38							
39							
40			6/8/9	6"/18"	40.0		
41					41.5	SS-8	
42							
43							
44	GRAY MEDIUM TO COARSE SAND, MEDIUM DENSE, SATURATED						
45			10/12/14	9"/18"	45.0		
46					46.5	SS-9	
47							

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-94
Project Name WESTLAKE	Page 4 of 7
Project No. 84-075-4-004	Date 4-18-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	GRAY MEDIUM TO COARSE SAND, MEDIUM DENSE, SATURATED						
49	— — — — — — —						
	GRAY COARSE SAND, SOME MEDIUM SAND, MEDIUM DENSE TO DENSE, SATURATED						
50					50.0		
			7/10/10	10"/18"		SS-10	
51					51.5		
52							
53	GRAVEL SEAM 53.0' TO 53.2'						
54							
55							
56							
57	GRAVEL SEAM 57.0' TO 57.8'						
58							
59							
60					60.0		
61			15/16/16	4"/18"		SS-11	
					61.5		
62							
63							
64							

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

Boring No.	D-94
Project Name: WESTLAKE	Page 5 of 7
Project No. 84-075-4-004	Date 4-18-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
66	GRAY COARSE SAND, SOME MEDIUM SAND, MEDIUM DENSE TO DENSE, SATURATED						
67	GRAVEL SEAM 67.0 TO 67.4.						
68							
69							
70			13/20/19	7"/18"	70.0		
71						SS-12	
					71.5		STOPPED 4-19-85 RESUMED 4-22-85
72	GRAVEL SEAM 72' TO 72.3'						
73							
74							
75							
76							
77							
78							
79							
80			9/20/22	6"/18"	80.0		
81						SS-13	
					81.5		

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-94
Project Name WESTLAKE	Page 6 of 7
Project No. 84-075-4-004	Date 4-18-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
83	GRAY COARSE SAND, SOME MEDIUM SAND, MEDIUM DENSE TO DENSE, SATURATED					
84						
85						
86	GRAVEL SEAM 86.0' TO 86.4'					
87	GRAY FINE TO COARSE SAND, VERY DENSE, SATURATED					
88						
89						
90	SILTY SAND SEAM 90.6 TO 90.8		22/32/36	7"/18"	SS-14	
91						
92						
93						
94						
95						
96						
97						
98						

Drilling Log, continued

	Boring No. D-94
Project Name WESTLAKE	Page 7 of 7
Project No. 84-075-4-004	Date 4-18-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
100	GRAY FINE TO COARSE SAND, VERY DENSE, SATURATED		14/28/27	4"/18"	100.0	SS-15	
101							
102							
103							
104							
105							STOPPED 4-23-85 RESUMED 4-24-85
106							
107							
108	GRAVEL						A 2" PVC, flush-joint, threaded couple piezometer was installed to 106'. 20' of .010 machine slotted screen.
109	LIMESTONE						
110	TOTAL DEPTH 109.0'						
111							HOLE collapsed to a depth of 65'.
112							Bentonite pellets 65' TO 64. Grout 64' to surface.
113							water level immediately after installation 4-23-85, 3:00pm
114							2.6' below T.O.P.
115							T.O.P is 4.0' above G.S.

Drilling Log

Project Name WESTLAKE				Boring No. D-95
Project No. 84-075-4-004				Page 1 of
Ground Elevation 453.09	Location			Total Footage

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
SEE REMARKS							

Drilling Co.	SUBSURFACE CONSTRUCTORS (WABASH)	Driller (s)	GARY JOHANNING
Drilling Rig.	CME 55, TRUCK	Type of Penetration Test	STANDARD
Date	4-22-85 To	Field Observer (s)	G. ERNSTMANN

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
	GRAVEL						6" HOLLOW AUGERS 0' TO 20'.
1	DARK BROWN SAND AND GRAVEL, MOIST (FILL)						
2							
3							
4							
5					5.0		
6			3/6/9	8" / 18"		SS-1	
7					6.5		
8							
9	BROWN TO BLACK SILT, SAND AND GRAVEL, VERY LOOSE, MOIST						
10					10.0		
11			2/3/2	9" / 18"		SS-2	
					11.5		
12							
13	BROWN FINE SANDY SILT, LOW PLASTICITY, VERY LOOSE, MOIST - SATURATED BELOW APPROX. 15'						

Drilling Log (continued)

		Boring No.	D-95
Project Name	WESTLAKE	Page	2 of
Project No.	84-075-4-004	Date	4-22-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	BROWN FINE SANDY SILT, LOW PLASTICITY, VERY LOOSE, MOIST - SATURATED BELOW APPROX. 15'						WATER LEVEL @ 13.6' BELOW G.S. 7:15am 4-23-85 (HOLE SAT OVERNIGHT AFTER BEING DRILLED 20')
15			2/2/3	6"/18"	15.0		
16						SS-3	
					16.5		
17							
18	— — — — — — —						
19	BROWN FINE TO MEDIUM SAND, LOOSE TO MEDIUM DENSE, SATURATED						
20					20.0		
21			1/3/3	6"/18"		SS-4	
					21.5		STOPPED 4-22-85 RESUMED 4-23-85 SET 4½" CASING AND BEGAN WASH BORING W/ 3⅞" DIA. TRI-CONE BIT,
22							
23							
24	SILTY SAND SEAM 25.0 TO 25.3'				24.0		
25			11/13/15	13"/18"		SS-5	
					26.5		
26	— — — — — — — —						
27	BROWN SILTY FINE TO MEDIUM SAND, DENSE, SATURATED						
28							
29					29.0		
30			15/21/20	12"/18"		SS-6	
					30.5		

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-95
Project Name WESTLAKE	Page 3 of
Project No.	Date 4-23-85

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
32	BROWN SILTY FINE TO MEDIUM SAND, DENSE, SATURATED						
33							
34			11/16/23	14"/18"	34.0	SS-7	
35					35.5		
36							
37	— — — — — —						
38	GRAY FINE TO MEDIUM SAND, MEDIUM DENSE TO VERY DENSE, SATURATED						
39			4/9/14	8"/18"	39.0	SS-8	
40					40.5		
41							
42							
43							
44			9/6/5	6"/18"	44.0	SS-9	
45					45.5		
46							
47	FEW THIN COARSE SAND SEAMS 47' TO 49'.						

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-95
Project Name WESTLAKE	Page 4 of
Project No. 84-075-4004	Date

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
49	GRAY FINE TO MEDIUM SAND, MEDIUM DENSE TO VERY DENSE, SATURATED		12/28/43	5"/18"	49.0		
50						SS-10	
					50.5		
51							
52							
53	— — — — — — —						
54	GRAY FINE TO COARSE SAND, TRACE FINE GRAVEL, DENSE						
55							
56							
57							
58							
59			11/13/24	6"/18"	59.0		
60						SS-11	
					60.5		
61							
62							
63							
64							

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Drilling Log (continued)

	Boring No. D-95
Project Name WESTLAKE	Page 5 of
Project No. 84-075-4-004	Date

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
66	— — — — — —						
67	GRAY FINE TO MEDIUM SAND, VERY DENSE, SATURATED						
68							
69			24/50/6"	10"/12"	69.0	SS-12	
70					70.0		
71							
72	GRAVEL SEAM 72.0'-72.2'						
73							
74							
75							
76	— — — — — — —						
77	GRAY COARSE SAND, SOME MEDIUM AND FINE SAND, VERY DENSE						
78							
79			16/25/27	7"/18"	79.0	SS-13	
80					80.5		
81							

Drilling Log, continued

Project Name WESTLAKE	Boring No. D-95
	Page 6 of
Project No. 84-075-4-004	Date

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
83	GRAY COARSE SAND, SOME MEDIUM AND FINE SAND, VERY DENSE, SATURATED						
84	GRAVEL SEAM 83.5 TO 83.8						
85							
86							
87							
88							
89					89.0		
90			15/23/29	7"/18"		SS-14	
					90.5		STOPPED 4-23-85 RESUMED 4-24-85
91							
92							
93							
94							
95	TRACE OF COARSE GRAVEL 95.5 TO						
96							
97							
98							

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

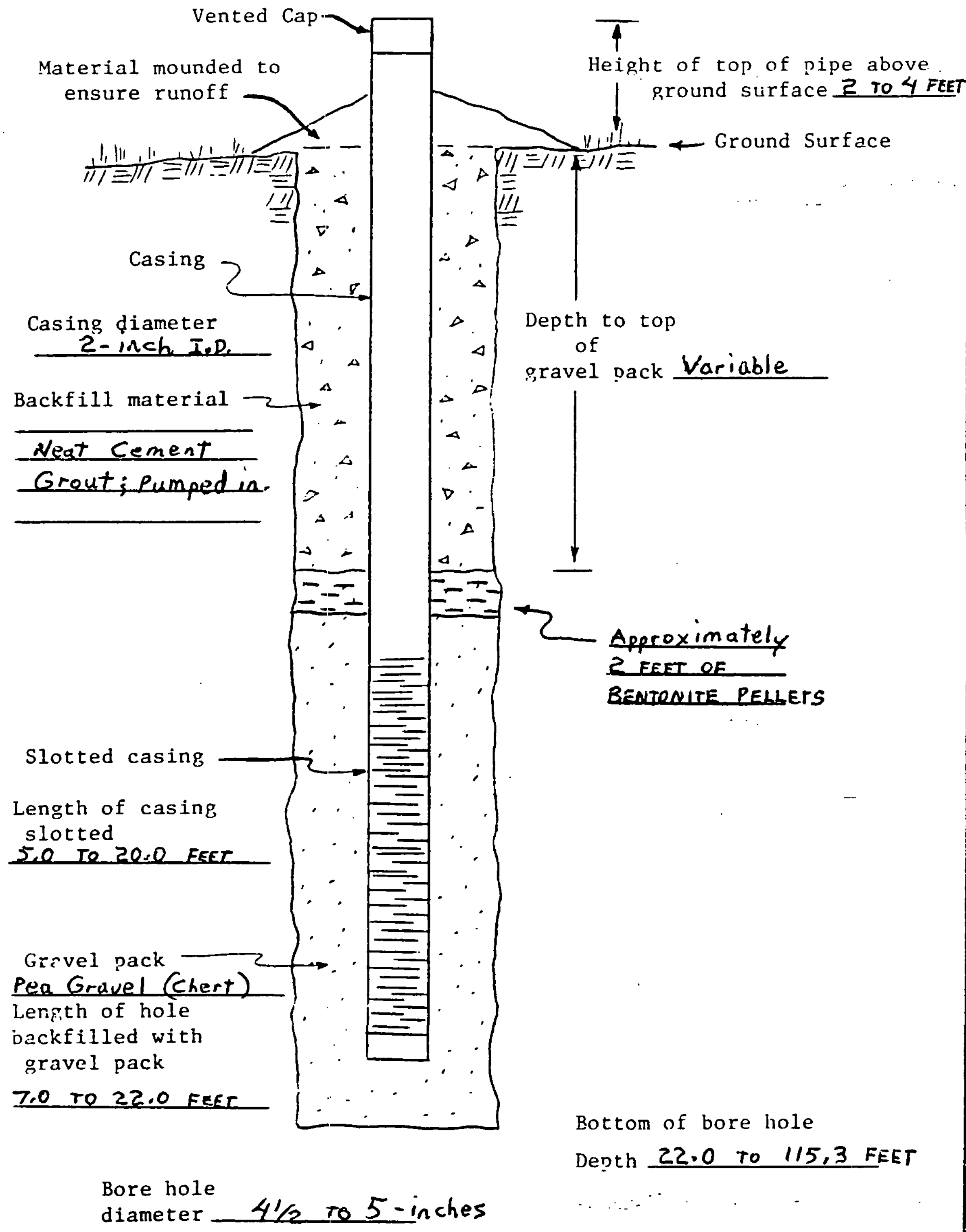
Drilling Log (continued)

	Boring No. D-95
Project Name WESTLAKE	Page 7 of
Project No. 84-075-4-004	Date

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
100	GRAY COARSE SAND, SOME MEDIUM AND FINE SAND, VERY DENSE, SATURATED		17/23/43	7"/18"	99.0–100.5	SS-15	
101	LIMESTONE TOTAL DEPTH 101.0'						A 2" dia., flush-joint, threaded couple PVC piezometer was installed to 101.0'. Bottom 20' is .010 machine slotted screen. Hole collapsed to 62' after PVC installed. Grout 62' to surface. T.O.P. is 3.3' above ground surface. Water level in piezometer immediately after installation ~~4-24~~-85 3:00pm is 16.7' below T.O.P.
102							
103							
104							
105							
106							
107							
108							
109							
110							
111							
112							
113							
114							
115							

APPENDIX B

PIEZOMETER CONSTRUCTION



date	PIEZOMETER CONSTRUCTION RECORD	project
designed		contract
Burns & McDonnell Engineers Architects Consultants, Kansas City, Missouri	Piezometer No. TYPICAL	dwg. no. rev.

Form GCO-1-9 051978

APPENDIX C

OBSERVED WATER LEVEL READINGS

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet ______ of ______

Project Name WESTLAKES	Project No. 84-075-4-002	Hole No. I-50 (old N-1)
Location	Elev. Ground Surface (G.S.) 449.0	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 453.48	
Date Started Drilling Hole — Time —	Total Depth of Hole 40.6	Drilling Type —
Date Completed Drilling Hole — Time —	Total Depth of Piezometer 40.6	Footage Slotted 10.0
Date Piezometer Installed — Time —		

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
4-26-84	11:15 am	P. Hustad	15.8' from T.O.P.	437.68	
6-21-84	10:40 am	R. Robinson	16.47' from T.O.P.	437.01	
8-8-84	3:48 pm	G. Ernstmann	18.62' from T.O.P.	434.86	
8-20-84	5:05 pm	G. Ernstmann	19.5' from T.O.P.	433.98	Electric tape (water level indicator)
8-29-84	7:15 am	G. Ernstmann	20.33 from T.O.P.	433.15	
10-3-84	9:04 am	R. Robinson	20.4 from T.O.P.	433.08	Electric Tape
10-26-84	12:55 pm	G. Ernstmann	18.80 from T.O.P.	434.68	Electric Tape
12-14-84	12:58 pm	G. Ernstmann	18.50 from T.O.P.	434.98	Electric Tape
3-30-85	2:25 pm	G. Ernstmann	15.50 from T.O.P.	437.98	steel tape
4-25-85	12:35 pm	G. Ernstmann	17.13 from T.O.P.	436.35	
6-7-85	11:[illegible] am	S. Payiatakis	19.96 from T.O.P.	[illegible]	
8-[illegible]-85	—	S. Payiatakis	19.14 from T.O.P.	434.34	[illegible] tape
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Form TS-GT-2-8

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet ______ of ______

Project Name WESTLAKES	Project No. 84-075-4-00[illegible]	Hole No. S-51 (old HL-3)

Location	Elev. Ground Surface (G.S.) 446.3
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 447.72
Date Started Drilling Hole ______ Time ______	Total Depth of Hole 25.8 — Drilling Type ______
Date Completed Drilling Hole ______ Time ______	
Date Piezometer Installed ______ Time ______	Total Depth of Piezometer 25.8 — Footage Slotted 3.0

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
4-26-84	11:38 am	A. Hustad	12.3 from T.O.P.	435.42	
5-24-84	12:45 pm	G. Ernstmann	13.0 from T.O.P.	434.72	
6-27-84	10:47 am	R. Robinson	13.36 from T.O.P.	434.36	
8-8-84	3:35 pm	G. Ernstmann	14.97 from T.O.P.	432.75	
8-20-84	5:10 pm	G. Ernstmann	15.75 from T.O.P.	431.97	Electric Tape (water level indicator)
8-29-84	10:45 am	G. Ernstmann	16.39 from T.O.P.	431.33	
10-3-84	9:20 am	R. Robinson	16.40 from T.O.P.	431.32	Electric Tape
10-26-84	12:45 pm	G. Ernstmann	15.35 from T.O.P.	432.37	Electric Tape
12-19-84	12:45 pm	G. Ernstmann	15.2 from T.O.P.	432.5	Electric Tape
3-30-85	2:20 pm	G. Ernstmann	12.58 from T.O.P.	435.14	Steel Tape
4-18-85	—	G. Ernstmann	13.00 from T.O.P.	434.72	
4-25-85	12:17 pm	G. Ernstmann	13.83 T.O.P.	433.89	
6-7-85	11:15 am	S. Payiatakis	13.88 from T.O.P.	433.84	
8-8-85	—	S. Payiatakis	15.74 from T.O.P.	431.98	Cloth Tape
12-13-85	—	M. Frio	12.33 from T.O.P.	435.39	Electric Tape
5-14-86	—	M. Frio	16.12 from T.O.P.	431.60	
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet ______ of ______

Project Name WESTLAKES	Project No. 84-075-4-002	Hole No. S-52 (old HL-2)
Location	Elev. Ground Surface (G.S.) 444.7	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 447.08	
Date Started Drilling Hole ____ Time ____	Total Depth of Hole 25.2	Drilling Type —
Date Completed Drilling Hole ____ Time ____		
Date Piezometer Installed ____ Time ____	Total Depth of Piezometer 25.2	Footage Slotted 3.0

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
4-26-84	11:28 am	P. Hustad	10.9 from T.O.P.	436.18	
5-23-84	7:00 am	G. Ernstmann	11.3 from T.O.P.	435.78	
6-27-84	10:51 am	R. Robinson	11.39 from T.O.P.	433.31	
8-8-84	3:40 pm	G. Ernstmann	12.98 from T.O.P.	434.10	
8-20-84	5:15 pm	G. Ernstmann	13.75 from T.O.P.	433.33	Electric Tape
8-29-84	10:50 am	G. Ernstmann	14.38 from T.O.P.	432.70	
10-3-84	9:25 Am	R. Robinson	14.54 from T.O.P.	432.54	Electric Tape
10-26-84	12:40 pm	G. Ernstmann	13.50 from T.O.P.	433.58	" "
12-19-84	12:41 pm	G. Ernstmann	13.3 from T.O.P.	434.8	" "
3-30-85	2:15 pm	G. Ernstmann	10.92 from T.O.P.	436.16	steel tape
4-18-85	—	G. Ernstmann	11.4 from T.O.P.	435.68	
4-25-85	12:25 pm	G. Ernstmann	12.0 from T.O.P.	435.08	
6-7-85	11:25 am	S. Payiatakis	11.90 from T.O.P.	435.18	
8-8-85	—	S. Payiatakis	13.96 from T.O.P.	433.32	cloth Tape
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

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Project Name WESTLAKES	Project No. 84-075-4-002	Hole No. S-53 (old HL-1)
Location	Elev. Ground Surface (G.S.) 444.8	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 449.00	
Date Started Drilling Hole ______ Time ______	Total Depth of Hole 23.7	Drilling Type ______
Date Completed Drilling Hole ______ Time ______	Total Depth of Piezometer 23.7	Footage Slotted 3.0
Date Piezometer Installed ______ Time ______		

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
4-26-84	11:32 am	P. Hustad	11.65 from T.O.P.	437.35	
5-23-84	1:05 pm	G. Ernstmann	11.85 from T.O.P.	437.15	
6-27-84	10:55 am	R. Robinson	11.94 from T.O.P.	437.06	
8-8-84	3:42 pm	G. Ernstmann	13.62 from T.O.P.	435.38	
8-20-84	5:20 pm	G. Ernstmann	14.3 from T.O.P.	434.7	Electric Tape
8-29-84	10:55 am	G. Ernstmann	14.96 from T.O.P.	434.04	
10-3-84	9:27 am	R. Robinson	15.09 from T.O.P.	433.91	Electric Tape
10-26-84	12:35 pm	G. Ernstmann	14.10 from T.O.P.	434.90	" "
12-12-84	12:37 pm	G. Ernstmann	14.0 from T.O.P.	435.0	" "
3-30-85	2:10 pm	G. Ernstmann	11.67 from T.O.P.	437.33	Steel tape
4-18-85	NOON	G. Ernstmann	12.1 from T.O.P.	436.90	
4-25-85	12:21 pm	G. Ernstmann	12.63 from T.O.P.	436.37	
6-7-85	11:35 am	S. Payiatakis	12.83 from T.O.P.	436.17	
8-8-85	—	S. Payiatakis	14.48 from T.O.P.	434.52	Cloth Tape
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name WESTLAKE	Project No. 84-075-4-002	Hole No. S-54 (old 36)
Location	Elev. Ground Surface (G.S.) 470.0	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 471.0	
Date Started Drilling Hole ____ Time ____	Total Depth of Hole 40.4	Drilling Type ____
Date Completed Drilling Hole ____ Time ____		
Date Piezometer Installed ____ Time ____	Total Depth of Piezometer 40.4	Footage Slotted 3.0

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
4-26-84	1:44pm	P. Hustad	34.2 from T.O.P.	436.8	
5-23-84	1:10pm	G. Ernstmann	34.2 from T.O.P.	436.8	
6-27-84	11:15am	R. Robinson	35.45 from T.O.P.	435.55	
8-8-84	4:15pm	G. Ernstmann	35.75 from T.O.P.	435.25	
8-20-84	4:28pm	G. Ernstmann	36.4 from T.O.P.	434.6	Electric tape (water level indicator)
8-24-84	1:15pm	G. Ernstmann	36.91 from T.O.P.	434.09	
8-29-84	10:15am	G. Ernstmann	37.24 from T.O.P.	433.76	
10-3-84	11:05am	R. Robinson	37.19 from T.O.P.	433.81	Electric Tape
10-26-84	10:10am	G. Ernstmann	36.20 from T.O.P.	434.80	" "
12-19-84	11:48am	G. Ernstmann	36.3 from T.O.P.	434.7	" "
3-30-85	1:35pm	G. Ernstmann	34.08 from T.O.P.	436.92	steel tape
4-25-85	9:02am	G. Ernstmann	34.75 from T.O.P.	436.25	
6-7-85	1:55pm	S. Payiatakis	34.84 from T.O.P.	436.16	
8-8-85	—	S. Payiatakis	36.83 from T.O.P.	434.17	Cloth Tape
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name WESTLAKE		Project No. 84-075-4-002	Hole No. I-55 (old 35)
Location		Elev. Ground Surface (G.S.) 471.9	
N	E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 475.1	
Date Started Drilling Hole ____	Time ____	Total Depth of Hole 60.0	Drilling Type ____
Date Completed Drilling Hole ____	Time ____		
Date Piezometer Installed ____	Time ____	Total Depth of Piezometer 60.0	Footage Slotted 3.0

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
4-26-84	1:40pm	P. Hustad	38.0 from T.O.P.	437.1	
5-23-84	4:15pm	G. Ernstmann	37.9 from T.O.P.	437.2	
6-27-84	11:20am	R. Robinson	38.02 from T.O.P.	437.08	
8-8-84	3:00pm	G. Ernstmann	39.55 from T.O.P.	435.55	
8-20-84	4:25pm	G. Ernstmann	40.4 from T.O.P.	434.7	Electric Tape
8-29-84	10:20am	G. Ernstmann	41.13 from T.O.P.	433.97	
10-3-84	11:10am	R. Robinson	41.15 from T.O.P.	433.95	Electric Tape
10-26-84	10:02am	G. Ernstmann	40.20 from T.O.P.	434.90	" "
12-19-84	11:45am	G. Ernstmann	40.2 from T.O.P.	434.9	" "
3-30-85	1:30pm	G. Ernstmann	37.83 from T.O.P.	437.27	steel tape
4-25-85	8:55am	G. Ernstmann	38.63 from T.O.P.	436.47	
6-7-85	1:50pm	S. Payiatakis	38.52 from T.O.P.	436.58	
8-8-85	—	S. Payiotakis	44.73 from T.O.P.	430.37	Cloth Tape
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name WESTLAKE	Project No. 84-075-4-002	Hole No. I-56 (old 34)
Location	Elev. Ground Surface (G.S.) 475.1	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 478.4	
Date Started Drilling Hole ____ Time ____	Total Depth of Hole 61.1	Drilling Type ____
Date Completed Drilling Hole ____ Time ____		
Date Piezometer Installed ____ Time ____	Total Depth of Piezometer 61.1	Footage Slotted 3.0

Remarks:

Date	Time	By Whom	Depth to Water*			W.L. Elev.	Remarks
4-26-84	1:36 pm	P. Hustad	41.45	from	T.O.P.	436.95	
4-25-84	8:10 am	G. Ernstmann	41.5	from	T.O.P.	436.9	
4-27-84	11:25 am	R. Robinson	41.67	from	T.O.P.	436.73	
8-8-84	2:55 pm	G. Ernstmann	43.34	from	T.O.P.	435.06	
8-20-84	3:55 pm	G. Ernstmann	44.0	from	T.O.P.	434.4	Electric Tape
8-29-84	10:22 am	G. Ernstmann	44.86	from	T.O.P.	433.54	
10-3-84	11:15 am	R. Robinson	44.97	from	T.O.P.	433.43	Electric Tape
10-26-84	9:57 am	G. Ernstmann	43.95	from	T.O.P.	434.45	" "
12-19-84	11:42 am	G. Ernstmann	44.0	from	T.O.P.	434.4	" "
3-30-85	1:25 pm	G. Ernstmann	41.42	from	T.O.P.	436.98	steel tape
4-25-85	8:48 am	G. Ernstmann	42.17	from	T.O.P.	436.23	
6-7-85	1:45 pm	S. Payiatakis	42.18	from	T.O.P.	436.22	
8-8-85	—	S. Payiatakis	44.43	from	T.O.P.	433.97	
				from			
				from			
				from			

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name WESTLAKE	Project No. 84-075-4-002		Hole No. I-58 (old 40)
Location		Elev. Ground Surface (G.S.) 477.5	
N	E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 480.5	
Date Started Drilling Hole ____	Time ____	Total Depth of Hole 60.0	Drilling Type ____
Date Completed Drilling Hole ____	Time ____		
Date Piezometer Installed ____	Time ____	Total Depth of Piezometer 60.0	Footage Slotted 3.0

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
4-26-84	1:30 pm	P. Hustad	43.5 from T.O.P.	437.0	
5-24-84	8:00 am	G. Ernstmann	43.3 from T.O.P.	437.2	
6-27-84	11:35 am	R. Robinson	43.55 from T.O.P.	436.95	
8-8-84	2:45 pm	G. Ernstmann	45.29 from T.O.P.	435.21	
8-20-84	4:10 pm	G. Ernstmann	46.15 from T.O.P.	434.35	Electric Tape
8-29-84	10:30 am	G. Ernstmann	46.81 from T.O.P.	433.69	
10-3-84	11:21 am	R. Robinson	47.02 from T.O.P.	433.48	Electric Tape
10-26-84	9:50 am	G. Ernstmann	46.00 from T.O.P.	434.50	" "
12-19-84	11:35 am	G. Ernstmann	46.0 from T.O.P.	434.5	" "
3-30-85	1:15 pm	G. Ernstmann	43.58 from T.O.P.	436.92	Steel tape
4-25-85	8:40 am	G. Ernstmann	44.04 from T.O.P.	436.46	
6-7-85	1:40 pm	S. Payiatakis	44.13 from T.O.P.	436.37	
8-8-85	—	S. Payiatakis	46.41 from T.O.P.	434.09	Cloth Tape
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name WESTLAKE	Project No. 84-075-4-002	Hole No. I-59 (old N-2)
Location	Elev. Ground Surface (G.S.) 444.9	
N / E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 448.67	
Date Started Drilling Hole ____ Time ____	Total Depth of Hole 43.5	Drilling Type ____
Date Completed Drilling Hole ____ Time ____		
Date Piezometer Installed ____ Time ____	Total Depth of Piezometer 43.5	Footage Slotted 10.0

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
4-26-84	1:22 pm	P. Hustad	12.55 from T.O.P.	436.12	
5-24-84	8:20 am	G. Ernstmann	12.7 from T.O.P.	435.97	
6-27-84	11:55 am	R. Robinson	12.92 from T.O.P.	435.75	
8-8-84	2:35 pm	G. Ernstmann	14.68 from T.O.P.	433.99	
8-20-84	10:48 am	G. Ernstmann	15.56 from T.O.P.	433.11	
8-24-84	2:15 pm	G. Ernstmann	15.84 from T.O.P.	432.83	
8-29-84	12:15 pm	G. Ernstmann	16.16 from T.O.P.	432.51	
10-3-84	11:27 am	R. Robinson	16.36 from T.O.P.	432.31	Electric Tape
10-26-84	9:47 am	G. Ernstmann	15.45 from T.O.P.	433.22	" "
12-19-84	11:18 am	G. Ernstmann	15.4 from T.O.P.	433.2	" "
3-30-85	12:47 pm	G. Ernstmann	13.00 from T.O.P.	435.67	steel tape
4-25-85	10:41 am	G. Ernstmann	13.42 from T.O.P.	435.25	
6-7-85	1:15 pm	S. Payiatakis	13.50 from T.O.P.	435.17	
8-8-85	—	S. Payiatakis	15.47 from T.O.P.	433.20	cloth Tape
12-13-85	—	M. Erio	14.43 from T.O.P.	434.24	Electric Tape
5-20-86	—	M. Erio	15.92 from T.O.P.	432.75	

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name: WESTLAKE	Project No. 84-075-4-002		Hole No. S-60 (old S-2)
Location		Elev. Ground Surface (G.S.) 443.1	
N	E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 446.93 (1) 446.30	
Date Started Drilling Hole ___	Time ___	Total Depth of Hole 21.0	Drilling Type ___
Date Completed Drilling Hole ___	Time ___	Total Depth of Piezometer 21.0	Footage Slotted ___
Date Piezometer Installed ___	Time ___		

Remarks:
(1) T.O.P = 446.93 prior to (4/17/85)
(2) T.O.P. = 446.30 beginning (4/17/85)

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
4-26-84	afternoon	P. Hustad	10.65 from T.O.P. (1)	436.28	
5-24-84	8:40 am	G. Ernstmann	10.7 from T.O.P. (1)	436.23	
6-27-84	10:41 am	R. Robinson	12.02 from T.O.P. (1)	434.91	
8-8-84	2:22 pm	G. Ernstmann	12.84 from T.O.P. (1)	434.09	
8-20-84	10:42 am	G. Ernstmann	13.74 from T.O.P. (1)	433.19	
8-29-84	12:02 pm	G. Ernstmann	14.4 from T.O.P. (1)	432.53	
10-3-84	11:36 am	R. Robinson	14.70 from T.O.P. (1)	432.23	Electric Tape
10-26-84	9:40 am	G. Ernstmann	13.95 from T.O.P. (1)	432.98	" "
12-19-84	11:12 am	G. Ernstmann	* 13.7(±.1) from T.O.P. (1)	433.2	Electric Tape. *Note: above-ground part of piez. is badly damaged.
3-30-85	12:37 pm	G. Ernstmann	* 1.17 from G.S.	441.93	Steel tape *Note: piez. is still damaged and was open at the surface
4-17-85	11:00 am	G. Ernstmann	10.4 from T.O.P. (2)	435.90	
4-25-85	10:31 am	G. Ernstmann	10.92 from T.O.P. (2)	435.38	
6-4-85	2:30 pm	S. Payiatakis	12.06 from T.O.P. (2)	434.24	Cloth Tape
6-7-85	1:30 pm	S. Payiatakis	11.03 from T.O.P. (2)	435.27	Cloth Tape
8-8-85	—	S. Payiatakis	12.98 from T.O.P. (2)	433.32	Cloth Tape
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name WESTLAKE	Project No. 84-075-4-002	Hole No. S-61 (old S-1)
Location	Elev. Ground Surface (G.S.) 445.6	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 450.17	
Date Started Drilling Hole ____ Time ____	Total Depth of Hole 21.5	Drilling Type ____
Date Completed Drilling Hole ____ Time ____		
Date Piezometer Installed ____ Time ____	Total Depth of Piezometer 21.5	Footage Slotted ____

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
4-26-84	afternoon	P. Hustad	13.3 from T.O.P.	436.87	
5-24-84	8:30am	G. Ernstmann	13.8 from T.O.P.	436.37	
6-27-84	12:07pm	K. Robinson	14.05 from T.O.P.	436.12	
8-8-84	2:20pm	G. Ernstmann	16.00 from T.O.P.	434.17	
8-20-84	10:38am	G. Ernstmann	16.90 from T.O.P.	433.27	
8-29-84	12:00 noon	G. Ernstmann	17.56 from T.O.P.	432.61	
10-3-84	11:40 am	R. Robinson	17.88 from T.O.P.	432.29	Electric Tape
10-26-84	9:20am	G. Ernstmann	17.00 from T.O.P.	433.17	" "
12-19-84	11:08am	G. Ernstmann	16.8 from T.O.P.	433.4	" "
3-30-85	12:35pm	G. Ernstmann	14.42 from T.O.P.	435.75	steel Tape
4-17-85	2:45pm	G. Ernstmann	14.1 from T.O.P.	436.07	Electric Tape
4-25-85	10:28 am	G. Ernstmann	14.42 from T.O.P.	435.75	" "
6-4-85	2:10 pm	S. Payiatakis	15.79 from T.O.P.	434.38	" "
6-7-85	8:47am	S. Payiatakis	14.89 from T.O.P.	435.28	" "
8-8-85	—	S. Payiatakis	16.72 from T.O.P.	433.45	cloth Tape
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name WESTLAKES	Project No. 84-075-4-002	Hole No. I-62 (old N-3)
Location	Elev. Ground Surface (G.S.) 444.1	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 446.08	
Date Started Drilling Hole ____ Time ____	Total Depth of Hole 44.0	Drilling Type ____
Date Completed Drilling Hole ____ Time ____	Total Depth of Piezometer 44.0	Footage Slotted 10.0
Date Piezometer Installed ____ Time ____		

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
4-26-84	afternoon	P. Hustad	8.9 from T.O.P.	437.18	
5-24-84	9:00 am	G. Ernstmann	9.4 from T.O.P.	436.68	
6-27-84	12:20 pm	R. Robinson	9.86 from T.O.P.	436.22	
8-10-84	7:35 am	G. Ernstmann	11.89 from T.O.P.	434.19	
8-16-84	8:00 am	G. Ernstmann	12.40 from T.O.P.	433.68	
8-20-84	7:30 am	G. Ernstmann	12.66 from T.O.P.	433.42	
8-21-84	11:30 am	G. Ernstmann	12.78 from T.O.P.	433.30	
8-28-84	10:40 am	G. Ernstmann	13.2 from T.O.P.	432.88	
8-29-84	1:15 pm	G. Ernstmann	13.35 from T.O.P.	432.73	
10-3-84	1:12 pm	R. Robinson	13.84 from T.O.P.	432.24	Electric Tape
10-26-84	9:12 am	G. Ernstmann	12.95 from T.O.P.	433.13	" "
12-19-84	10:45 am	G. Ernstmann	12.7 from T.O.P.	433.4	" "
3-30-85	12:02 pm	G. Ernstmann	10.04 from T.O.P.	436.04	" "
4-25-85	11:00 am	G. Ernstmann	10.17 from T.O.P.	435.91	" "
6-7-85	9:07 am	S. Payiatakis	10.32 from T.O.P.	435.76	" "
8-8-85	—	S. Payiatakis	[illegible] from T.O.P.	433.63	cloth Tape

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name WESTLAKES	Project No. 84-075-4-002	Hole No. I-65 (old N-4)

Location	Elev. Ground Surface (G.S.) 438.5
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 441.80
Date Started Drilling Hole ____ Time ____	Total Depth of Hole 36.0 — Drilling Type ____
Date Completed Drilling Hole ____ Time ____	
Date Piezometer Installed ____ Time ____	Total Depth of Piezometer 36.0 — Footage Slotted 10.0

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
4-26-84	12:52 pm	P. Hustad	4.5' from T.O.P.	437.3	
5-24-84	11:00 am	G. Ernstmann	5.0' from T.O.P.	436.8	
6-27-84	1:12 pm	R. Robinson	5.46 from T.O.P.	436.34	
8-8-84	1:40 pm	G. Ernstmann	7.43 from T.O.P.	434.37	
8-21-84	12:20 pm	G. Ernstmann	8.42 from T.O.P.	433.38	
8-30-84	8:55 am	G. Ernstmann	9.18 from T.O.P.	432.62	
10-3-84	11:50 am	R. Robinson	9.45 from T.O.P.	432.35	Electric Tape
10-26-84	12:08 pm	G. Ernstmann	8.55 from T.O.P.	433.25	" "
12-19-84	10:10 am	G. Ernstmann	8.4 from T.O.P.	433.4	" "
3-30-85	2:45 pm	G. Ernstmann	5.33 from T.O.P.	436.47	steel tape
4-25-85	11:10 am	G. Ernstmann	5.83 from T.O.P.	435.97	Electric Tape
6-7-85	8:25 am	S. Payiatakis	6.25 from T.O.P.	435.55	" "
8-8-85	—	S. Payiatakis	7.76 from T.O.P.	433.82	cloth tape
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name WESTLAKES	Project No. 84-075-4-002	Hole No. I-66 (old N-5)
Location	Elev. Ground Surface (G.S.) 437.7	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 441.80	
Date Started Drilling Hole ____ Time ____	Total Depth of Hole 36.9	Drilling Type ____
Date Completed Drilling Hole ____ Time ____		
Date Piezometer Installed ____ Time ____	Total Depth of Piezometer 36.9	Footage Slotted 10.0

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
4-26-84	afternoon	P. Hustad	* from		* water in ditch has surrounded the piezometer
5-24-84	11:15 am	G. Ernstmann	4.9' from T.O.P.	436.9	Water in ditch, at base of piezometer, is 3.4' below T.O.P. (438.4)
6-27-84	1:10 pm	R. Robinson	5.40 from T.O.P.	436.4	
8-8-84	1:43 pm	G. Ernstmann	7.42 from T.O.P.	434.38	
8-21-84	12:25 pm	G. Ernstmann	8.38 from T.O.P.	433.42	
8-30-84	9:05 am	G. Ernstmann	9.05 from T.O.P.	432.75	
10-3-84	11:55 am	R. Robinson	9.36 from T.O.P.	432.44	Electric Tape
10-26-84	12:15 pm	G. Ernstmann	8.25 from T.O.P.	433.55	" "
12-19-84	10:15 am	G. Ernstmann	8.2 from T.O.P.	433.6	" "
3-30-85	—	G. Ernstmann	see Remarks from —	—	Piez. is inaccessible because of water in ditch.
4-25-85	—	G. Ernstmann	" from "	—	" " " " "
6-7-85	—	S. Payialakis	" from —	—	2' of water @ surface
8-8-85	—	S. Payialakis	7.63 from T.O.P.	434.17	cloth tape
5-20-86	—	M. Frio	9.12 from T.O.P.	432.68	
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name WESTLAKES	Project No. 84-075-4-002	Hole No. I-G7 (old N-6)
Location	Elev. Ground Surface (G.S.) 436.5	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 439.08	
Date Started Drilling Hole ____ Time ____	Total Depth of Hole 35.4	Drilling Type ____
Date Completed Drilling Hole ____ Time ____		
Date Piezometer Installed ____ Time ____	Total Depth of Piezometer 35.4	Footage Slotted 10.0

Remarks:

Date	Time	By Whom	Depth to Water*			W.L. Elev.	Remarks
4-26-84	afternoon	P. Hustad	*	from	—	—	* water in ditch is above the T.O.P.
5-24-84	11:30am	G. Ernstmann	*	from	—	—	* water in ditch is above the T.O.P.
6-27-84	1:24pm	R. Robinson	2.61	from	T.O.P.	436.47	
8-8-84	1:35pm	G. Ernstmann	4.65	from	T.O.P.	434.43	
8-21-84	12:50pm	G. Ernstmann	5.55	from	T.O.P.	433.53	
8-30-84	9:10am	G. Ernstmann	6.22	from	T.O.P.	432.86	
10-3-84	noon	R. Robinson	6.42	from	T.O.P.	432.66	Electric Tape
12-19-84	10:19am	G. Ernstmann	5.3	from	T.O.P.	433.8	" "
3-30-85	—	G. Ernstmann	see Remarks	from	—	—	Piez. is inaccessible because of water in ditch.
4-25-85	—	G. Ernstmann	"	from	—	—	Piezometer is underwater.
6-4-85	—	S. Payiatakis	"	from	—	—	" " "
8-8-85	—	S. Payiatakis	4.75	from	T.O.P.	434.32	cloth Tape
				from			
				from			
				from			
				from			

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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GEOTECHNICAL DEPARTMENT

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Project Name: WESTLAKE	Project No. 84-075-4-002		Hole No. I-68 (old N-7)
Location		Elev. Ground Surface (G.S.) 440.9	
N	E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 448.32	
Date Started Drilling Hole ____	Time ____	Total Depth of Hole 31.2	Drilling Type ____
Date Completed Drilling Hole ____	Time ____		
Date Piezometer Installed ____	Time ____	Total Depth of Piezometer 31.2	Footage Slotted 10.0

Remarks:

Date	Time	By Whom	Depth to Water*			W.L. Elev.	Remarks
4-26-84	12:37pm	P. Hustad	10.9	from	T.O.P.	437.42	
5-24-84	11:45am	G. Ernstmann	11.5	from	T.O.P.	436.82	
6-27-84	1:30pm	R. Robinson	12.25	from	T.O.P.	436.07	
8-8-84	1:47pm	G. Ernstmann	14.02	from	T.O.P.	434.30	
8-21-84	6:55 am	G. Ernstmann	14.9	from	T.O.P.	433.42	Electric tape
8-30-84	9:20 am	G. Ernstmann	15.70	from	T.O.P.	432.62	
10-3-84	10:01 am	R. Robinson	15.84	from	T.O.P.	432.48	Electric Tape
10-26-84	12:00 noon	G. Ernstmann	14.55	from	T.O.P.	433.77	" "
12-19-84	10:40 am	G. Ernstmann	14.6	from	T.O.P.	433.7	" "
3-30-85	11:35am	G. Ernstmann	11.17	from	T.O.P.	437.15	" "
4-25-85	11:24 am	G. Ernstmann	12.29	from	T.O.P.	436.03	" "
6-4-85	1:10pm	S. Paylatakis	13.51	from	T.O.P.	434.81	" "
6-7-85	8:05 am	S. Paylatakis	11.30	from	T.O.P.	437.02	" "
8-8-85	—	S. Paylatakis	14.17	from	T.O.P.	434.15	Cloth tape
				from			
				from			

***Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).**

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Project Name WESTLAKES	Project No. 84-075-4-002	Hole No. I-72 (old 39)	
Location		Elev. Ground Surface (G.S.) 462.7	
N	E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 465.4	
Date Started Drilling Hole ____	Time ____	Total Depth of Hole 50.0	Drilling Type ____
Date Completed Drilling Hole ____	Time ____		
Date Piezometer Installed ____	Time ____	Total Depth of Piezometer 50.0	Footage Slotted 3.0

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
4-26-84	2:28pm	P. Hustad	28.15 from T.O.P.	437.25	
5-23-84	1:00pm	G. Ernstmann	28.4 from T.O.P.	437.00	
6-27-84	1:35pm	R. Robinson	28.66 from T.O.P.	436.74	
8-8-84	3:15pm	G. Ernstmann	30.22 from T.O.P.	435.18	
8-20-84	1:10pm	G. Ernstmann	31.05 from T.O.P.	434.35	Electric tape
8-29-84	10:25am	G. Ernstmann	31.81 from T.O.P.	433.59	
10-3-84	9:40am	R. Robinson	31.92 from T.O.P.	433.48	Electric Tape
10-26-84	10:35am	G. Ernstmann	31.05 from T.O.P.	434.35	" "
12-19-84	12:18pm	G. Ernstmann	30.8 from T.O.P.	434.2	" "
3-30-85	11:50am	G. Ernstmann	28.58 from T.O.P.	436.82	" "
4-25-85	8:14am	G. Ernstmann	29.21 from T.O.P.	436.19	" "
6-4-85	2:30pm	S. Payiatakis	30.10 from T.O.P.	435.30	" "
6-7-85	9:40am	S. Payiatakis	29.33 from T.O.P.	436.07	" "
8-8-85	—	S. Payiatakis	31.28 from T.O.P.	434.12	cloth tape
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name WESTLAKE	Project No. 84-075-4-002	Hole No. I-73 (old 38)	
Location		Elev. Ground Surface (G.S.) 462.7	
N	E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 465.4	
Date Started Drilling Hole ____	Time ____	Total Depth of Hole 50.0	Drilling Type ____
Date Completed Drilling Hole ____	Time ____		
Date Piezometer Installed ____	Time ____	Total Depth of Piezometer 50.0	Footage Slotted 3.0

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
4-26-84	2:31 pm	P. Hustad	26.15 from T.O.P.	436.55	
5-23-84	1:15 pm	G. Ernstmann	26.5 from T.O.P.	436.2	
6-27-84	1:40 pm	R. Robinson	26.67 from T.O.P.	436.03	
8-8-84	3:17 pm	G. Ernstmann	28.62 from T.O.P.	436.78	
8-20-84	1:15 pm	G. Ernstmann	29.61 from T.O.P.	435.79	Electric Tape
8-29-84	10:27 am	G. Ernstmann	30.13 from T.O.P.	435.27	
10-3-84	9:43 am	R. Robinson	29.97 from T.O.P.	435.43	Electric Tape
10-26-84	10:38 am	G. Ernstmann	29.20 from T.O.P.	436.20	" "
12-19-84	12:20 pm	G. Ernstmann	29.1 from T.O.P.	436.3	" "
3-30-85	11:53 am	G. Ernstmann	27.17 from T.O.P.	438.23	" "
4-25-85	8:17 am	G. Ernstmann	27.58 from T.O.P.	437.87	" "
6-4-85	2:50 pm	S. Paylatakis	28.48 from T.O.P.	436.92	" "
6-7-85	9:50 am	S. Paylatakis	27.68 from T.O.P.	437.72	" "
8-8-85	—	S. Paylatakis	29.48 from T.O.P.	435.92	cloth Tape
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name WESTLAKE	Project No. 84-075-4-002	Hole No. 74 Q
Location	Elev. Ground Surface (G.S.)	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) approx. 465' ± 5'	
Date Started Drilling Hole Time	Total Depth of Hole	Drilling Type
Date Completed Drilling Hole Time		
Date Piezometer Installed Time	Total Depth of Piezometer	Footage Slotted

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
4-26-84	2:36pm	P. Hustad	17.3 from T.O.P.	≈ 448	
5-23-84	1:15pm	G. Ernstmann	15.5' from *T.O.P.	≈ 450	* highest point on top of Tilted concrete casing
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name WESTLAKE	Project No. 84-075-4-002	Hole No. S-75 (old 37)
Location	Elev. Ground Surface (G.S.) 458.8	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 459.9	
Date Started Drilling Hole ____ Time ____	Total Depth of Hole 26.0	Drilling Type ____
Date Completed Drilling Hole ____ Time ____		
Date Piezometer Installed ____ Time ____	Total Depth of Piezometer 26.0	Footage Slotted 3.0

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
4-26-84	2:03 pm	P. Hustad	21.4 from T.O.P.	438.5	
5-24-84	12:30 pm	G. Ernstmann	22.4 from T.O.P.	437.5	
6-27-84	11:00 am	R. Robinson	22.53 from T.O.P.	437.37	
8-8-84	4:05 pm	G. Ernstmann	24.33 from T.O.P.	435.57	
8-20-84	4:45 pm	G. Ernstmann	25.0 from T.O.P.	434.9	Electric tape
8-24-84	1:05 pm	G. Ernstmann	25.37 from T.O.P.	434.53	
8-29-84	10:05 am	G. Ernstmann	25.70 from T.O.P.	434.2	
10-3-84	10:58 am	R. Robinson	25.53 from T.O.P.	434.37	Electric Tape
10-26-84	10:22 am	G. Ernstmann	24.15 from T.O.P.	435.75	" "
12-19-84	11:55 am	G. Ernstmann	24.3 from T.O.P.	435.6	" "
3-30-85	1:55 pm	G. Ernstmann	17.50 from T.O.P.	442.4	steel tape
4-17-85	–	"	24.1 from "	435.80	
4-25-85	9:07 AM	"	22.88 from "	437.02	
6-7-85	12:30 PM	S. Payiatakis	17.70 from "	442.20	
8-8-85	–	"	21.18 from "	438.72	Cloth Tape
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name WESTLAKE	Project No. 84-075-4-002	Hole No. S-76 (old 37A)
Location	Elev. Ground Surface (G.S.) 474.4	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 477.5	
Date Started Drilling Hole ___ Time ___	Total Depth of Hole 50.0	Drilling Type ___
Date Completed Drilling Hole ___ Time ___	Total Depth of Piezometer 50.0	Footage Slotted 3.0
Date Piezometer Installed ___ Time ___		

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
4-27-84	9:30am	Bill Canney	40.7 from T.O.P.	436.8	
5-23-84	4:00pm	G. Ernstmann	40.5 from T.O.P.	437.0	
6-27-84	11:05am	R. Robinson	40.54 from T.O.P.	436.96	
8-8-84	4:10 pm	G. Ernstmann	42.21 from T.O.P.	435.29	
8-20-84	4:35 pm	G. Ernstmann	42.95 from T.O.P.	434.55	Electric tape
8-24-84	1:10 pm	G. Ernstmann	43.36 from T.O.P.	434.14	
8-29-84	10:15am	G. Ernstmann	43.69 from T.O.P.	433.81	
10-26-84	10:15am	G. Ernstmann	42.80 from T.O.P.	434.70	Electric Tape
12-19-84	11:52am	G. Ernstmann	42.6 from T.O.P.	434.9	" "
3-30-85	1:45 pm	G. Ernstmann	40.92 from T.O.P.	436.58	steel Tape
4-25-85	9:05 AM	"	40.04 from "	437.46	
6-7-85	2:00 PM	S. Payiatakis	41.79 from "	435.71	
8-8-85	–	"	43.24 from "	434.26	Cloth Tape
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name WESTLAKE	Project No. 84-075-4-002	Hole No. S-80
Location	Elev. Ground Surface (G.S.) 448.4	
N 2592.7962 E 2619.0159	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 453.38	
Date Started Drilling Hole 8-28-84 Time —	Total Depth of Hole 22.0'	Drilling Type SOLID AUGERS
Date Completed Drilling Hole 8-29-84 Time —	Total Depth of Piezometer 20.0'	Footage Slotted 10.0'
Date Piezometer Installed 8-29-84 Time 9:00 am		

Remarks:

Date	Time	By Whom	Depth to Water*			W.L. Elev.	Remarks
8-28-84	—	G. Ernstmann	≈ 14'	from	G.S.	≈ 439	saturated material encountered during drilling.
8-29-84	7:00 am	G. Ernstmann	12.9'	from	G.S.	440.48	water level standing in hole during drilling.
8-29-84	9:00 am	G. Ernstmann	18.17	from	T.O.P.	435.21	immediately after piezometer installation.
8-29-84	9:30 am	G. Ernstmann	17.4	from	T.O.P.	435.98	
10-3-84	8:57 AM	A. ROBINSON	18.6	from	T.O.P.	434.78	Electric Tape
10-26-84	12:50 pm	G. Ernstmann	17.10	from	T.O.P.	436.28	" "
12-19-84	12:55 pm	G. Ernstmann	14.4	from	T.O.P.	439.0	" "
3-30-85	2:30 pm	G. Ernstmann	11.50	from	T.O.P.	441.88	steel tape
4-17-85	–	"	9.90	from	"	443.48	
4-25-85	12:29 PM	"	11.29	from	"	442.09	
6-7-85	10:55 AM	S. Payiotakis	14.18	from	"	439.20	Cloth Tape
8-8-85	–	"	15.62	from	"	437.76	
12-13-85	–	M. Erio	10.90	from	"	442.45	Electric Tape
5-19-86	–	"	16.65	from	"	436.73	
				from			
				from			

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name WESTLAKE	Project No. 84-075-4-002		Hole No. D-81
Location		Elev. Ground Surface (G.S.) 447.8	
N 1146.2728	E 922.0145	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 450.82	
Date Started Drilling Hole 8-13-84	Time —	Total Depth of Hole 61.5'	Drilling Type WASH BORING
Date Completed Drilling Hole 8-15-84	Time —		
Date Piezometer Installed 8-15-84	Time 11:00 am	Total Depth of Piezometer 60.0'	Footage Slotted 15.0'

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
8-13-84	3:30 pm	G. Ernstmann	≈ 13' from G.S.	≈438	saturated material encountered during drilling.
8-15-84	3:05 pm	G. Ernstmann	16.63' from T.O.P.	434.19	4 hours after piezometer installation.
8-20-84	4:50 pm	G. Ernstmann	17.6' from T.O.P.	433.22	Electric tape
8-21-84	9:15 am	G. Ernstmann	17.6' from T.O.P.	433.22	just before evacuating piezometer with compressed air
8-21-84	9:37 am	G. Ernstmann	17.75' from T.O.P.	433.07	2 mins. after evacuating piezometer
8-24-84	1:25 pm	G. Ernstmann	16.94' from T.O.P.	433.88	
8-29-84	12:35 pm	G. Ernstmann	18.28 from T.O.P.	432.54	
10-26-84	10:25 am	G. Ernstmann	17.35 from T.O.P.	433.47	Electric Tape
12-19-84	12:02 pm	G. Ernstmann	17.3 from T.O.P.	433.5	" "
3-30-85	2:35 pm	G. Ernstmann	14.92 from T.O.P.	435.90	Steel Tape
4-25-85	9:10 AM	"	15.88 from "	434.94	
6-7-85	12:35 PM	S. Payiatakis	15.73 from "	435.09	
8-8-85	—	"	17.68 from "	433.14	Cloth Tape
12-13-85	—	M. Erio	14.71 from "	436.11	Electric Tape.
5-19-86	—	"	18.12 from "	432.70	
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name WESTLAKE	Project No. 84-075-4-002	Hole No. S-82	
Location N 599,1580 E 19,3231	Elev. Ground Surface (G.S.) 447.7		
	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 450-69		
Date Started Drilling Hole 8-24-84	Time —	Total Depth of Hole 26.5'	Drilling Type WASH-BORING
Date Completed Drilling Hole 8-27-84	Time —	Total Depth of Piezometer 25.5'	Footage Slotted 10.0'
Date Piezometer Installed 8-27-84	Time 1:45 pm		

Remarks:

Date	Time	By Whom	Depth to Water*			W.L. Elev.	Remarks
8-24-84	—	G. Ernstmann	11' to 13' and below 17'	from	G.S.	below 434'	saturated material encountered during drilling.
8-27-84	1:45pm	G. Ernstmann	18.2	from	T.O.P.	432.49	immediately after piezometer installation.
8-29-84	12:20pm	G. Ernstmann	18.25'	from	T.O.P.	432.44	
10-3-84	11:30am	R. Robinson	18.34	from	T.O.P.	432.35	Electric Tape
10-26-84	9:45 am	G. Ernstmann	17.51	from	T.O.P.	433.18	" "
12-19-84	11:17 am	G. Ernstmann	17.5	from	T.O.P.	433.2	" "
3-30-85	12:45 pm	G. Ernstmann	15.00	from	T.O.P.	435.69	steel Tape
4-17-85	—	"	15.00	from	"	435.69	
4-25-85	10:37 AM	"	15.46	from	"	435.23	
6-7-85	12:45 PM	S. Payiatakis	15.56	from	"	435.13	
8-8-85	—	"	17.53	from	"	433.16	Cloth Tape
5-20-86	→	M. Erio	18.00	from	"	432.69	
12-12-85	—	"	14.40	from	"	436.29	
				from			
				from			
				from			

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

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Project Name WESTLAKE	Project No. 84-075-4-002	Hole No. D-83
Location	Elev. Ground Surface (G.S.) 444.4	
N 1742,7093 E 1219,4580	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 447.62	
Date Started Drilling Hole 8-16-84 Time —	Total Depth of Hole 115.3'	Drilling Type WASH BORING
Date Completed Drilling Hole 8-20-84 Time —		
Date Piezometer Installed 8-21-84 Time 2:05 pm	Total Depth of Piezometer 97.0'	Footage Slotted 20.0'

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
8-16-84	—	G. Ernstmann	10.5' from G.S.	437.1	saturated material encountered during drilling.
8-21-84	2:05 pm	G. Ernstmann	14.50' from T.O.P.	433.12	Immediately after piezometer installation.
8-27-84	10:40 am	G. Ernstmann	14.84' from T.O.P.	432.78	just prior to evacuating piezometer with compressed air.
8-27-84	11:17 am	G. Ernstmann	15.0' from T.O.P.	432.62	4 minutes after evacuating the piezometer.
8-29-84	1:05 pm	G. Ernstmann	15.04' from T.O.P.	432.58	
10-3-84	1:10 pm	R. Robinson	15.39 from T.O.P.	432.23	Electric Tape
10-26-84	9:10 am	G. Ernstmann	14.55 from T.O.P.	433.07	" "
12-19-84	10:47 am	G. Ernstmann	14.4 from T.O.P.	433.2	" "
3-30-85	12:00 noon	G. Ernstmann	11.46 from T.O.P.	436.16	" "
4-25-85	10:58 AM	"	11.83 from "	435.79	
6-7-85	9:05 AM	S. Papiafakis	12.14 from "	435.48	
8-8-85	—	"	14.18 from "	433.44	Cloth Tape
12-12-85	—	M. Erio	10.56 from	437.06	Electric Tape
5-19-86	—	"	15.08 from	432.54	
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Project Name WEST LAKE	Project No. 84-075-4-002		Hole No. S-84
Location		Elev. Ground Surface (G.S.) 452.9	
N 340.0038	E 1998.2729	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 456.72	
Date Started Drilling Hole 8-24-84	Time —	Total Depth of Hole 31.5'	Drilling Type SOLID AUGERS
Date Completed Drilling Hole 8-24-84	Time —		
Date Piezometer Installed 8-24-84	Time 12:20 pm	Total Depth of Piezometer 30.9'	Footage Slotted 10.0'

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
8-24-84	—	G. Ernstmann	13' TO 20' from G.S.		few thin saturated zones encountered during drilling.
8-24-84	—	G. Ernstmann	20' from G.S.	437'	saturated material below 20' during drilling.
8-24-84	12:20pm	G. Ernstmann	23.7' from T.O.P.	433.22	immediately after piezometer installation.
8-27-84	7:15 am	G. Ernstmann	23.91' from T.O.P.	433.01	
8-27-84	9:20 am	G. Ernstmann	23.92' from T.O.P.	433.00	Just prior to evacuating piezometer with compressed air
8-27-84	2:15 pm	G. Ernstmann	23.98 from T.O.P.	432.94	about 4½ hrs. after evacuating the piezometer
8-30-84	9:16 am	G. Ernstmann	24.28 from T.O.P.	432.64	
10-3-84	10:05 am	R. Robinson	24.32 from T.O.P.	432.60	Electric Tape
10-26-84	11:56 am	G. Ernstmann	23.20 from T.O.P.	433.72	" "
12-19-84	10:35 am	G. Ernstmann	23.3 from T.O.P.	433.6	" "
3-30-85	11:22 am	G. Ernstmann	20.33 from T.O.P.	436.59	" "
4-25-85	11:15 AM	"	20.83 from "	436.09	
6-4-85	12:30 PM	S. Payiatakis	22.25 from "	434.67	
6-7-85	8:00 AM	"	21.16 from "	435.76	
8-8-85	—	"	22.96 from "	433.96	Cloth Tape
12-13-85	—	M. Erio	19.85 from "	437.07	Electric Tape

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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GEOTECHNICAL DEPARTMENT

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Sheet 2 of 2

Project Name WESTLAKE	Project No. 34-075-4-002	Hole No. S-84
Location	Elev. Ground Surface (G.S.) See sheet 1	
N see sheet 1 E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) " " 1	
Date Started Drilling Hole " " " Time "	Total Depth of Hole " " "	Drilling Type " " "
Date Completed Drilling Hole " " " Time "		
Date Piezometer Installed " " " Time "	Total Depth of Piezometer " " "	Footage Slotted " " "

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
5-20-86	—	M. Erio	24.19 from T.O.P.	432.73	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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GEOTECHNICAL DEPARTMENT

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Project Name WESTLAKE	Project No. 84-075-4-002		Hole No. D-85
Location		Elev. Ground Surface (G.S.) 453.1	
N 340.5414	E 1986.8430	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 457.15	
Date Started Drilling Hole 8-21-84	Time —	Total Depth of Hole 84.1'	Drilling Type WASH BORING
Date Completed Drilling Hole 8-22-84	Time —		
Date Piezometer Installed 8-24-84	Time 10:00 am	Total Depth of Piezometer 82.0'	Footage Slotted 20.0'

Remarks:

Date	Time	By Whom	Depth to Water*			W.L. Elev.	Remarks
8-22-84	7:30 am	G. Ernstmann	approx. 18' to 25'	from	G.S.		saturated material encountered during drilling.
8-24-84	10:00 am	G. Ernstmann	20.05	from	T.O.P.	437.10	immediately after piezometer installation.
8-27-84	7:15 am	G. Ernstmann	24.09	from	T.O.P.	433.06	
8-27-84	9:40 am	G. Ernstmann	24.12	from	T.O.P.	433.03	Just prior to evacuating piezometer with compressed air.
8-27-84	2:20 pm	G. Ernstmann	24.21	from	T.O.P.	432.94	about 4½ hrs. after evacuating the piezometer.
8-30-84	9:15 am	G. Ernstmann	24.50	from	T.O.P.	432.65	
10-3-84	10:07 am	R. Robinson	24.54	from	T.O.P.	432.61	Electric Tape
10-26-84	11:55 am	G. Ernstmann	23.35	from	T.O.P.	433.80	" "
12-19-84	10:37 am	G. Ernstmann	23.5	from	T.O.P.	433.6	" "
3-30-85	11:20 am	G. Ernstmann	20.62	from	T.O.P.	436.53	" "
4-25-85	—	"	21.08	from	"	436.07	
6-4-85	12:55 PM	S. Payiatakis	22.48	from	"	434.67	
6-7-85	8:00 AM	"	21.23	from	"	435.92	
8-8-85	—	"	23.22	from	"	433.93	Cloth Tape
12-11-85	—	M. Erio	20.20	from	"	436.95	Electric Tape
5-20-86	—	"	24.40	from	"	432.75	

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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GEOTECHNICAL DEPARTMENT

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Project Name WESTLAKE		Project No. 84-075-4-002	Hole No. D-87
Location		Elev. Ground Surface (G.S.) 460.0	
N 114.45	E 903.6487	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 463.04	
Date Started Drilling Hole 8-9-84	Time —	Total Depth of Hole 111.7'	Drilling Type WASH BORING
Date Completed Drilling Hole 8-10-84	Time —	Total Depth of Piezometer 111.0'	Footage Slotted 20.0'
Date Piezometer Installed 8-10-84	Time —		

Remarks:

Date	Time	By Whom	Depth to Water*			W.L. Elev.	Remarks
8-9-84	—	G. Ernstmann	27'	from	G.S.		saturated material encountered during drilling.
8-10-84	—	G. Ernstmann	4.46	from	T.O.P.	458.58	immediately after piezometer installation.
8-14-84	8:15 am	G. Ernstmann	26.05'	from	T.O.P.	436.99	
8-20-84	12:50 pm	G. Ernstmann	29.75'	from	T.O.P.	433.29	
8-23-84	1:30 pm	G. Ernstmann	30.0'	from	T.O.P.	433.04	before surging well.
8-23-84	3:30 pm	G. Ernstmann	30.3'	from	T.O.P.	432.74	few minutes after surging and bailing the well.
8-27-84	10:15 am	G. Ernstmann	29.29'	from	T.O.P.	433.75	just prior to evacuating piezometer with compressed air.
8-27-84	10:32 am	G. Ernstmann	30.5'	from	T.O.P.	432.54	4 minutes after evacuating the piezometer.
8-29-84	11:15 am	G. Ernstmann	30.46	from	T.O.P.	432.58	
10-3-84	9:50 am	R. Robinson	30.61	from	T.O.P.	432.43	Electric Tape
10-26-84	10:45 am	G. Ernstmann	29.75	from	T.O.P.	433.29	" "
12-19-84	10:43 am	G. Ernstmann	29.6	from	T.O.P.	433.4	" "
3-30-85	11:39 am	G. Ernstmann	27.09	from	T.O.P.	435.95	" "
4-25-85	~~8:30~~ 8:20 AM	"	27.50	from	"	435.54	
6-4-85	1:20 PM	S. Payiatakis	28.74	from	"	434.30	
6-7-85	8:35 PM	"	27.88	from	"	435.16	

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Observed Water Level Readings

Sheet 2 of 2

Project Name WESTLAKE	Project No. 84-075-4-002		Hole No. D-87
Location		Elev. Ground Surface (G.S.) See Sheet 1	
N See sheet 1 E		Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) "	
Date Started Drilling Hole "	Time "	Total Depth of Hole "	Drilling Type "
Date Completed Drilling Hole "	Time "		
Date Piezometer Installed "	Time "	Total Depth of Piezometer "	Footage Slotted "

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
8-8-85	—	"	29.78 from "	433.26	Cloth Tape
12-11-85	—	M. Erio	26.75 from "	436.54	Electric Tape
5-20-86	—	"	27.75 from "	435.29	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Sheet 1 of 2

Project Name WESTLAKE	Project No. 84-075-4-002		Hole No. S-88
Location N 695.0461 E 309.2279	Elev. Ground Surface (G.S.) 460.0		
	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 462.73		
Date Started Drilling Hole 8-15-84 Time —	Total Depth of Hole 41.5'	Drilling Type WASH BORING	
Date Completed Drilling Hole 8-16-84 Time —			
Date Piezometer Installed 8-16-84 Time 11:00 am	Total Depth of Piezometer 40.0'	Footage Slotted 10.0'	

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
8-15-84	—	G. Ernstmann	18' to 24' from G.S.		saturated seams encountered during drilling.
8-15-84		G. Ernstmann	24' from G.S.	439'	saturated material encountered during drilling below 24'.
8-16-84	11:00 am	G. Ernstmann	29.3' from T.O.P.	433.43	immediately after piezometer installation.
8-20-84	1:00 pm	G. Ernstmann	29.50' from T.O.P.	433.23	Electric tape
8-21-84	8:38 am	G. Ernstmann	29.46' from T.O.P.	433.27	just before evacuating piezometer with compressed air
8-21-84	9:01 am	G. Ernstmann	29.8' from T.O.P.	432.93	1½ mins. after evacuating piezometer
8-24-84	1:30 pm	G. Ernstmann	29.90' from T.O.P.	432.83	
8-29-84	11:10 am	G. Ernstmann	30.20 from T.O.P.	432.53	
10-3-84	10:45 am	R. Robinson	30.34 from T.O.P.	432.39	Electric Tape
10-26-84	10:40 am	G. Ernstmann	29.50 from T.O.P.	433.23	" "
12-19-84	12:11 pm	G. Ernstmann	29.4 from T.O.P.	433.3	" "
3-30-85	11:45 am	G. Ernstmann	27.00 from T.O.P.	435.37	" "
4-25-85	8:25 AM	"	27.50 from "	435.23	
6-4-85	2:10 PM	S. Payiatacis	28.81 from "	433.92	
6-7-85	9:17 AM	"	27.71 from "	435.02	
8-8-85	—	"	29.65 from "	433.08	Cloth Tape

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Observed Water Level Readings

Sheet 2 of 2

Project Name WESTLAKE	Project No. 84-075-4-002	Hole No. 5-88	
Location		Elev. Ground Surface (G.S.) See Sheet 1	
N See Sheet 1 E		Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) "	
Date Started Drilling Hole "	Time "	Total Depth of Hole "	Drilling Type "
Date Completed Drilling Hole "	Time "		
Date Piezometer Installed "	Time "	Total Depth of Piezometer "	Footage Slotted "

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
12-11-85	–	M. Erio	26.48 from T.O.P.	436.25	Electric Tape
5-20-86	–	"	29.79 from "	432.94	" "
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name WESTLAKE	Project No. 84-075-4-002		Hole No. D-89
Location		Elev. Ground Surface (G.S.) 454.1	
N 1790.5514	E 602.6094	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 457.10	
Date Started Drilling Hole 8-27-84	Time —	Total Depth of Hole 49.0'	Drilling Type WASH BORING
Date Completed Drilling Hole 8-28-84	Time —		
Date Piezometer Installed 8-28-84	Time 1:30 pm	Total Depth of Piezometer 49.0'	Footage Slotted 15.0'

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
8-27-84	—	G. Ernstmann	15' to 20' from G.S.		few thin saturated zones encountered during drilling.
8-27-84	—	G. Ernstmann	21' from G.S.		saturated material encountered during drilling below 21'.
8-28-84	1:30pm	G. Ernstmann	22.3' from T.O.P	434.8	immediately after piezometer installation.
8-29-84	10:30 am	G. Ernstmann	24.50 from T.O.P.	432.60	Just prior to evacuating piezometer with compressed air
8-29-84	11:45 am	G. Ernstmann	24.65 from T.O.P.	432.45	10 minutes after evacuating the piezometer.
10-3-84	9:33 am	R. Robinson	24.73 from T.O.P.	432.37	Electric Tape
10-26-84	12:19 pm	G. Ernstmann	23.65 from T.O.P.	433.45	" "
12-19-84	12:30 pm	G. Ernstmann	23.6 from T.O.P.	433.5	" "
3-30-85	2:00 pm	G. Ernstmann	21.25 from T.O.P.	435.85	steel tape
4-25-85	11:35 AM	"	22.13 from "	434.97	
6-4-85	1:15 PM	S. Payiatakis	22.95 from "	434.15	
6-7-85	10:05 AM	"	22.01 from "	435.09	
8-8-85	—	"	24.10 from "	433.00	Cloth Tape
12-13-85	—	M. Erio	21.07 from "	436.03	Electric Tape
5-19-86	—	"	24.79 from "	432.81	
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name WESTLAKE	Project No. 84-075-4-002	Hole No. Earth City #8
Location Earth City, west of the landfill	Elev. Ground Surface (G.S.)	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 441.87	
Date Started Drilling Hole — Time —	Total Depth of Hole —	Drilling Type —
Date Completed Drilling Hole — Time —		
Date Piezometer Installed — Time —	Total Depth of Piezometer —	Footage Slotted —

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
8-30-84	12:30pm	G. Ernstmann	8.7 from T.O.P.	433.17	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name WESTLAKE	Project No. 84-075-4-002	Hole No. Earth City #9
Location Earth City, west of the landfill	Elev. Ground Surface (G.S.) approx. 436	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 441.85	
Date Started Drilling Hole — Time —	Total Depth of Hole —	Drilling Type —
Date Completed Drilling Hole — Time —		
Date Piezometer Installed — Time —	Total Depth of Piezometer —	Footage Slotted —

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
10-26-84	1:20pm	G. Ernstmann	7.4 from T.O.P.	434.45	
12-19-84	11:22am	G. Ernstmann	7.7 from T.O.P.	434.2	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name WESTLAKE	Project No. 84-075-4-002		Hole No. Earth City #12
Location Earth City, west of the landfill		Elev. Ground Surface (G.S.)	
N	E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.)	440.59
Date Started Drilling Hole —	Time —	Total Depth of Hole —	Drilling Type —
Date Completed Drilling Hole —	Time —	Total Depth of Piezometer —	Footage Slotted —
Date Piezometer Installed —	Time —		

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
8-30-84	1:00pm	G. Ernstmann	7.7 from T.O.P.	432.89	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Project Name WESTLAKE	Project No. 84-075-4-002	Hole No. SMP-63
Location Ponded surface water north of site, southwest of St. Charles Rock Road	Elev. Ground Surface (G.S.)	
N — E —	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.)	
Date Started Drilling Hole N.A. Time —	Total Depth of Hole N.A.	Drilling Type N.A.
Date Completed Drilling Hole N.A. Time —		
Date Piezometer Installed N.A. Time —	Total Depth of Piezometer N.A.	Footage Slotted N.A.

Remarks:

Reference point is a rod located in the ponded water north of the site in the ditch southwest of St. Charles Rock Road. The rod is marked in increments of 0.1 foot and starts with 0.0 at the bottom and ends at approximately 12-feet at the top. The top of the rod is under water during most of the spring and early summer.

Date	Time	By Whom	~~Depth to~~ Height of Water*			W.L. Elev.	Remarks
10-15-84	12:15pm	Bill Canney	10.21	from	R.P.		
10-26-84	9:15am	G. Ernstmann	11.05	from	R.P.		
12-19-84	10:53 am	G. Ernstmann	11.4	from	R.P.		
3-30-84	—	G. Ernstmann	*	from	—		* Reference rod is submerged in ponded water.
				from			
				from			
				from			
				from			
				from			
				from			
				from			
				from			
				from			
				from			
				from			
				from			

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Observed Water Level Readings

Sheet ______ of ______

Project Name WESTLAKE	Project No. 84-075-4-004	Hole No. D-90
Location	Elev. Ground Surface (G.S.)	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 450.60	
Date Started Drilling Hole 8-6-85 Time	Total Depth of Hole 47.0'	Drilling Type Solid Auger & Rotary Wash
Date Completed Drilling Hole 8-7-85 Time	Total Depth of Piezometer 47.0'	Footage Slotted 10'
Date Piezometer Installed 8-7-85 Time 9:50 AM		

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
12-13-85	–	M. Erio	13.87 from T.O.P.	436.73	Electric Tape
5-19-86	–	"	15.38 from "	435.22	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Form TS-GT-2-8

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet ______ of ______

Project Name WESTLAKE	Project No. 84-075-4-004		Hole No. D-91
Location		Elev. Ground Surface (G.S.)	
N	E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 453.37	
Date Started Drilling Hole 8-5-85	Time	Total Depth of Hole 45.0	Drilling Type Solid Auger
Date Completed Drilling Hole 8-6-85	Time	Total Depth of Piezometer 45.0	Footage Slotted 10'
Date Piezometer Installed 8-6-85	Time 9:00		

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
12-13-85	—	M. Erio	15.42 from T.O.P.	437.95	Electric Tape
5-19-86	—	"	17.29 from "	434.08	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet ______ of ______

Project Name WESTLAKE	Project No. 84-075-4-002		Hole No. O-92
Location		Elev. Ground Surface (G.S.) ≈ 475.5	
N	E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 475.37	
Date Started Drilling Hole 4-9-85	Time	Total Depth of Hole 143.6	Drilling Type
Date Completed Drilling Hole 4-11-85	Time		
Date Piezometer Installed 4-11-85	Time	Total Depth of Piezometer 143.0	Footage Slotted 20'

Remarks:

Date	Time	By Whom	Depth to Water*			W.L. Elev.	Remarks
4-17-85	11:15 AM	G. Ernstmann	38.9	from	T.O.P.	436.47	
4-22-85	10:30 AM	"	40.2	from	"	435.17	
4-23-85	3:30 PM	"	39.3	from	"	436.07	
4-24-85	7:00 AM	"	40.5	from	"	434.87	
4-25-85	8:30 AM	"	40.04	from	"	435.33	Electric Tape
6-4-85	1:40 PM	S. Payiatakis	41.17	from	"	434.20	
6-7-85	8:40 AM	"	38.06	from	"	437.31	
8-8-85	-	"	42.08	from	"	433.29	Cloth Tape
12-12-85	-	M. Erio	38.55	from	"	436.82	Electric Tape
5-19-86	-	"	42.40	from	"	432.97	
				from			
				from			
				from			
				from			
				from			
				from			

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet ______ of ______

Project Name WESTLAKE	Project No. 84-075-4-002	Hole No. D-93
Location	Elev. Ground Surface (G.S.) ≈ 448	
N / E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 450.7	
Date Started Drilling Hole 4-15-85 / Time	Total Depth of Hole 119.2	Drilling Type Wash bore
Date Completed Drilling Hole 4-18-85 / Time	Total Depth of Piezometer 112'	Footage Slotted 20'
Date Piezometer Installed 4-18-85 / Time 1:30PM		

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
4-22-85	10:30 AM	G. Ernstmann	15.3 from T.O.P	435.4	
4-24-85	7:00 AM	"	15.5 from "	435.2	
4-25-85	–	"	15.46 from "	435.24	Electric Tape
6-7-85	1:00 PM	S. Payiatakis	15.51 from "	435.19	
8-8-85	–	"	17.50 from "	453.20	cloth Tape
12-12-85	–	M. Erio	14.24 from "	436.46	Electric Tape
5-20-86	–	"	17.94 from "	432.76	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet ______ of ______

Project Name WESTLAKE	Project No. 84-075-4-002	Hole No. D-94
Location N E	Elev. Ground Surface (G.S.) ≈ 438.5	
	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 442.68	
Date Started Drilling Hole 4-18-85 Time	Total Depth of Hole 109.0	Drilling Type Wash boring
Date Completed Drilling Hole 4-24-85 Time	Total Depth of Piezometer 106.0	Footage Slotted 20'
Date Piezometer Installed 4-24-85 Time 3:00 PM		

Remarks:

Date	Time	By Whom	Depth to Water*			W.L. Elev.	Remarks
4-25-85	11:08AM	G. Ernstmann	7.29	from	T.O.P.	435.39	Electric Tape
6-4-85	1:50 PM	S. Payiatakis	7.88	from	"	434.80	
6-7-85	8:15 AM	"	6.98	from	"	435.70	
8-8-85	–	"	8.75	from	"	433.93	Cloth Tape
12-12-85	–	M. Erio	5.25	from	"	437.43	Electric Tape.
5-20-86	–	"	10.90	from	"	431.78	
				from			
				from			
				from			
				from			
				from			
				from			
				from			
				from			
				from			
				from			

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet ____ of ____

Project Name WESTLAKE	Project No. 84-075-4-002	Hole No. D-95
Location	Elev. Ground Surface (G.S.) ≈450	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 453.09	
Date Started Drilling Hole 4-22-85 Time	Total Depth of Hole 100.0	Drilling Type H.S. Auger & wash boring
Date Completed Drilling Hole 4-24-85 Time		
Date Piezometer Installed 4-24-85 Time 3:00 PM	Total Depth of Piezometer 101.0	Footage Slotted 20

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
4-25-85	12:00 PM	G. Ernstmann	16.75 from T.O.P.	436.34	Electric Tape
6-7-85	10:35 AM	S. Payiatakis	17.02 from "	436.07	
8-8-85	—	"	19.01 from "	434.08	Cloth Tape
12-12-85	—	M. Erio	15.35 from "	437.74	Electric Tape.
5-21-86	—	"	20.46 from "	432.63	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

APPENDIX D

LABORATORY TEST DATA ON
SOIL ENGINEERING PROPERTIES

TABLE D-1

Permeability of Alluvium

Boring	Depth	Sample	Method	Permeability (cm/sec)
D-81	50.0 to 50.6	SS-9a	* Hazen's Formula	2.5×10^{-1}
D-83	73.5 to 97.0	N.A.	** Bailer Test	5.11×10^{-4}
D-83	70.0 to 71.5	SS-12	Hazen's Formula	9.0×10^{-2}
D-83	90.0 to 91.5	SS-14	Hazen's Formula	2.5×10^{-1}
D-85	40.0 to 41.5	SS-8	Hazen's Formula	4.0×10^{-2}
D-85	70.0 to 71.5	SS-11	Hazen's Formula	1.2×10^{-2}
D-87	87.0 to 111.0	N.A.	Bailer Test	3.35×10^{-4}
D-87	100.0 to 101.0	SS-20	Hazen's Formula	6.8×10^{-2}
S-88	30.0 to 31.5	SS-5	Hazen's Formula	2.3×10^{-2}
S-88	29.0 to 40.0	N.A.	Bailer Test	1.45×10^{-3}
D-89	32.5 to 49.0	N.A.	Bailer Test	2.44×10^{-4}

* Hazen's Formula is used to estimate permeability based upon soil grain size distribution. (see Hazen, A., 1930, Water Supply, American Civil Engineers Handbook, John Wiley and Sons, Inc., N.Y.)

** A bailer test is a field method for determining in-situ permeability. Water was evacuated from the piezometer with a compressed air pump and the rate of recovery recorded. The rate of recovery is related to the soil permeability (see Hvorslev, M. Juul, 1951, Time Lag and Soil Permeability in Groundwater Observations, Waterways Experiment Station, Corps of Engineers, U.S. Army, Vicksburg, Mississippi, Bulletin No. 36.)

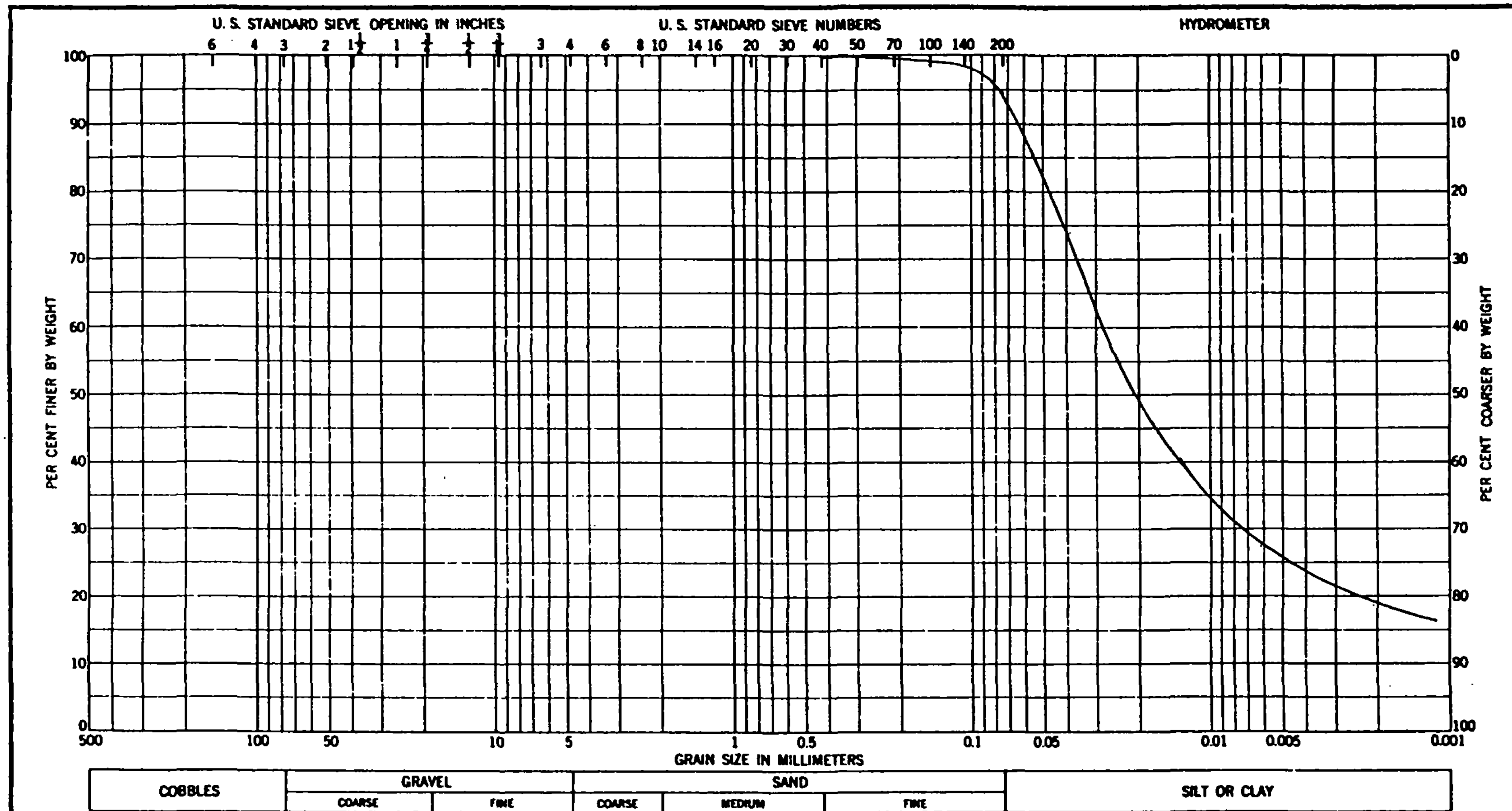
SUMMARY OF SOIL TESTS

PROJECT Westlake

PROJECT NO 84-075-4-002

BORING NUMBER	SAMPLE NUMBER	DEPTH ft	% MOISTURE	DRY UNIT WT.— PCF	UNCONFINED COMPRESSION		ATTERBERG LIMITS			% -200	UNIFIED CLASSIFICATION					REMARKS
					PSF	%E	LL	PL	PI							
S-80	ST-3	15.0-17.0	34.9	87.9						94.6						
	ST-4	20.0-22.0	48.3	75.8			57	21	36		CH					
D-81	SS-9A	50.0-50.6								0.7						
D-83	SS-3A	15.0-15.7	32.4	90.7			25	21	4		CL/ML					
	SS-12	70.0-71.5								2.3						
	SS-14	90.0-91.5								1.2						
D-85	SS-8	40.0-41.5								3.4						
	SS-11	70.0-71.5								3.6						
D-87	SS-20	100.0-101.0								2.3						
S-88	SS-5	30.0-31.5								2.2						

Kansas City Testing Laboratory



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
ST-3	15.0-17.0		34.9			

Project Westlake

Job No. 84-075-4-002

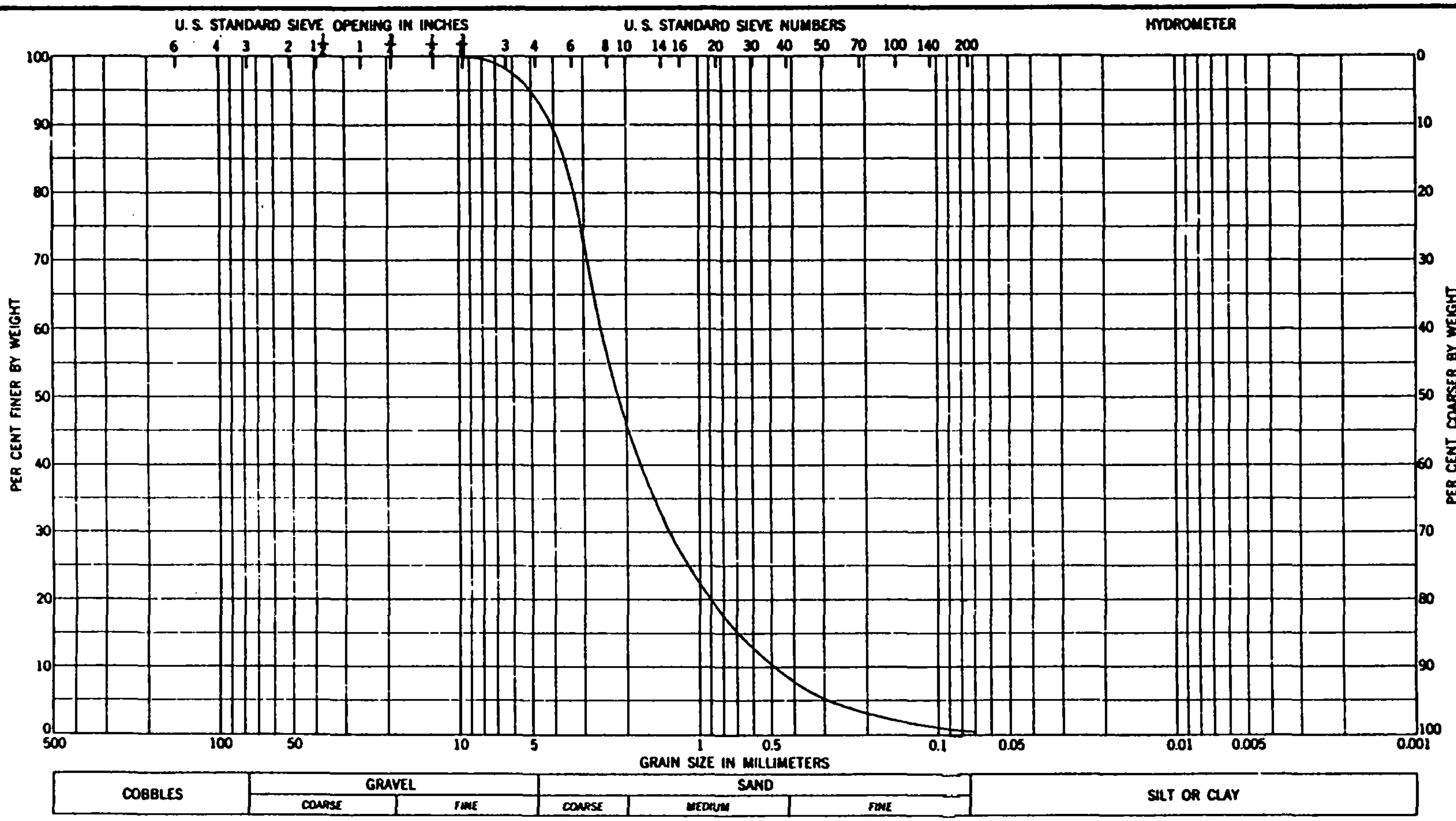
Area

Boring No S-80

Date

GRADATION CURVES

KANSAS CITY TESTING LABORATORY



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
SS-9A	50.0-50.6					

GRADATION CURVES

Project Westlake

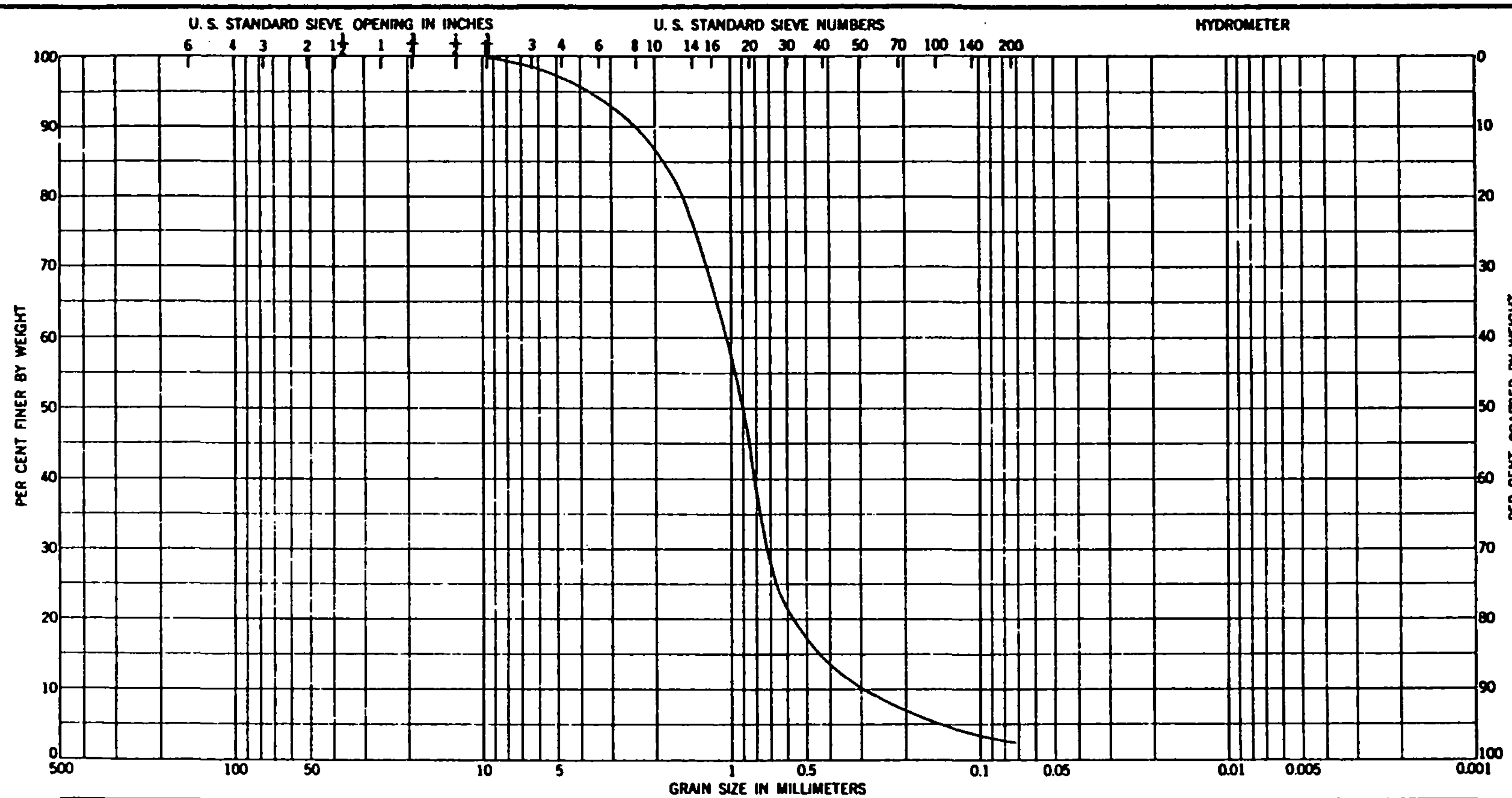
Job No. 84-075-4-002

Area

Boring No. D-81

Date

KANSAS CITY TESTING LABORATORY



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
SS-12	70.0-71.5					

Project Westlake

Job No. 84-075-4-002

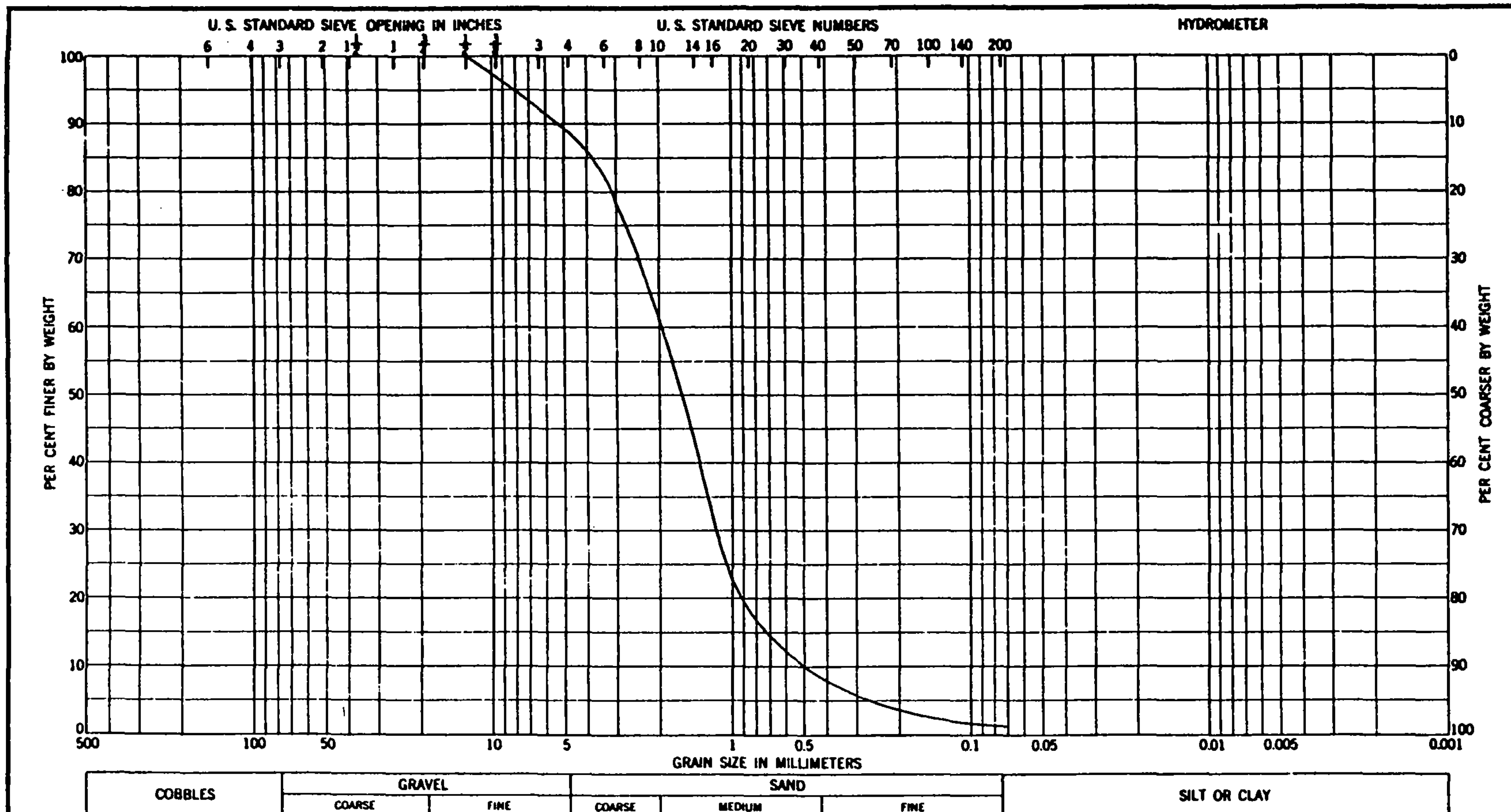
Area

Boring No. D-83

Date

GRADATION CURVES

KANSAS CITY TESTING LABORATORY



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
SS-14	90.0-91.5					

Project Westlake

Job No. 84-075-4-002

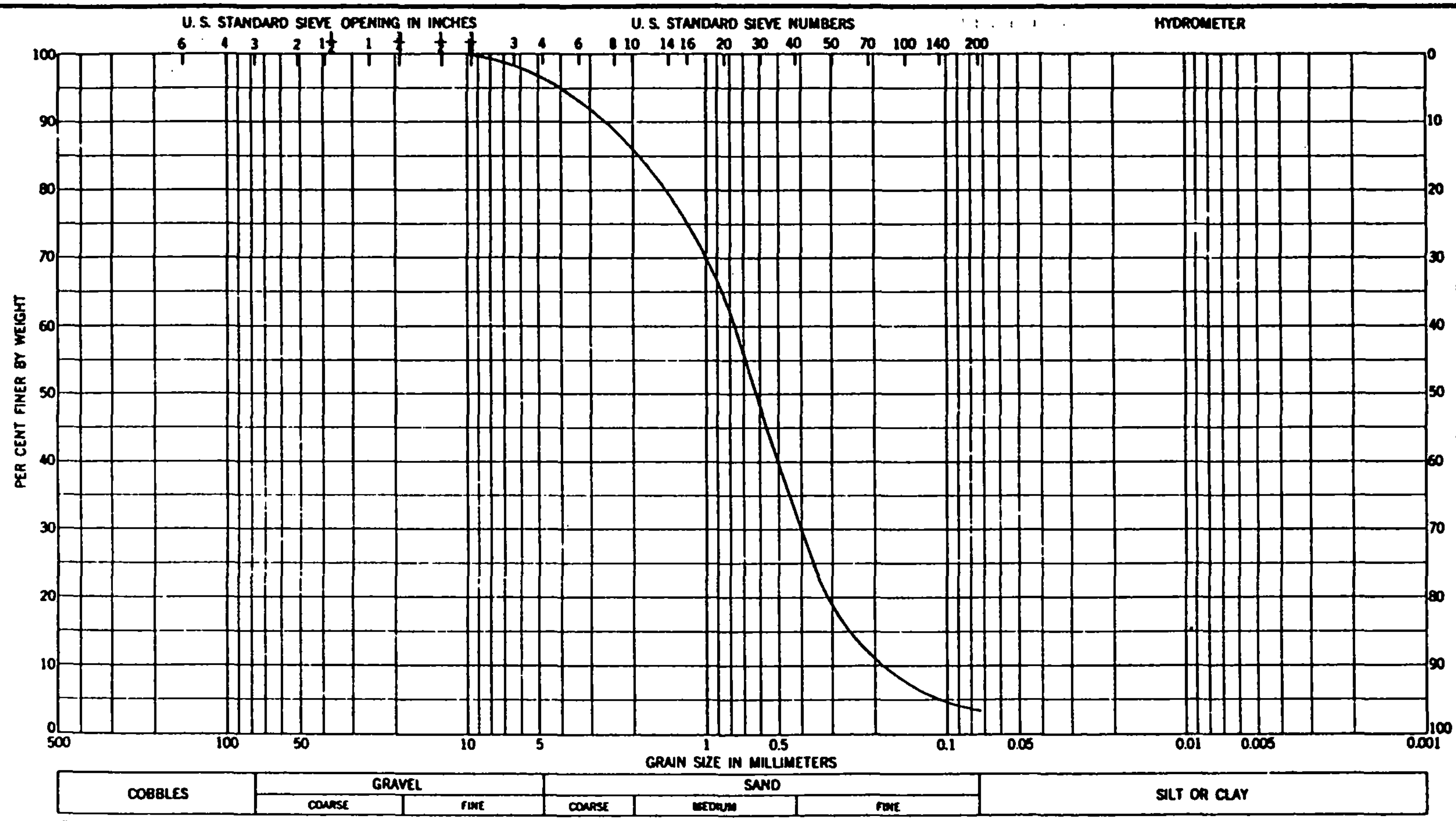
Area

Boring No. D-83

Date

GRADATION CURVES

KANSAS CITY TESTING LABORATORY



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
SS-8	40.0-41.5					

Project Westlake

Job No. 84-075-4-002

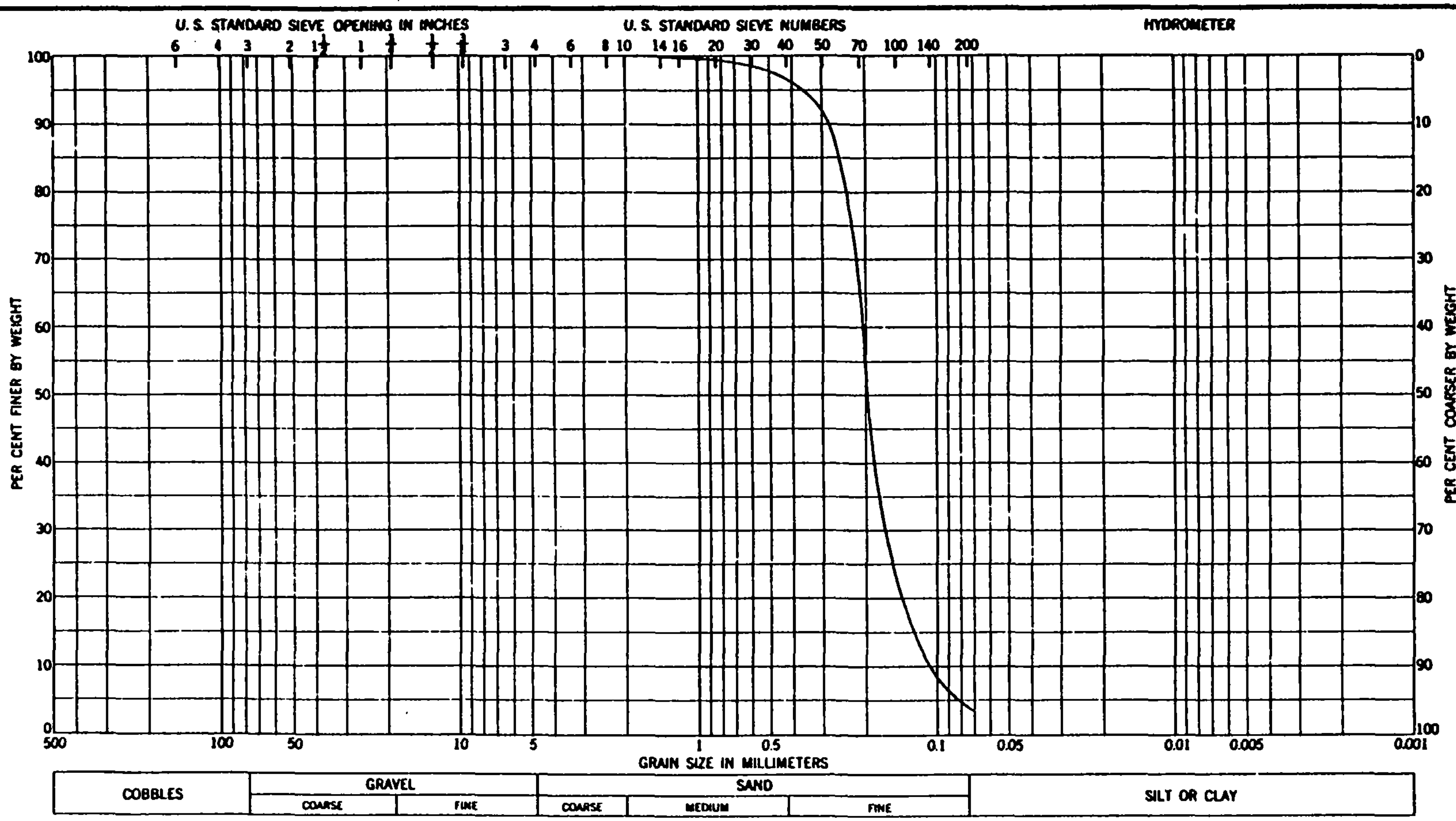
Area

Boring No. D-85

Date

GRADATION CURVES

KANSAS CITY TESTING LABORATORY



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
SS-11	70.0-71.5					

Project Westlake

Job No. 84-075-4-00

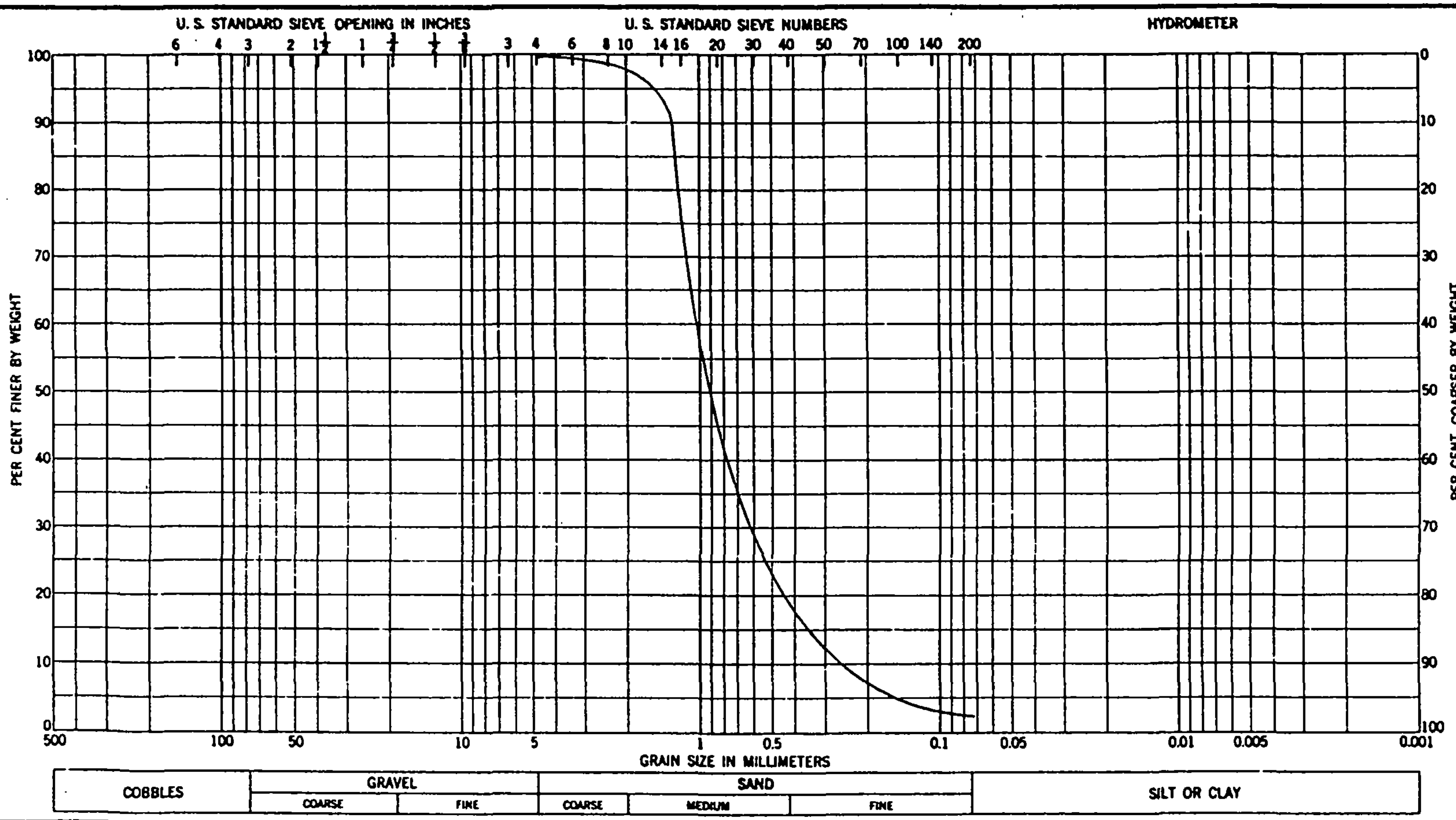
Area

Boring No. D-85

Date

GRADATION CURVES

KANSAS CITY TESTING LABORATORY



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
SS-20	100.0-101.0					

GRADATION CURVES

Project Westlake

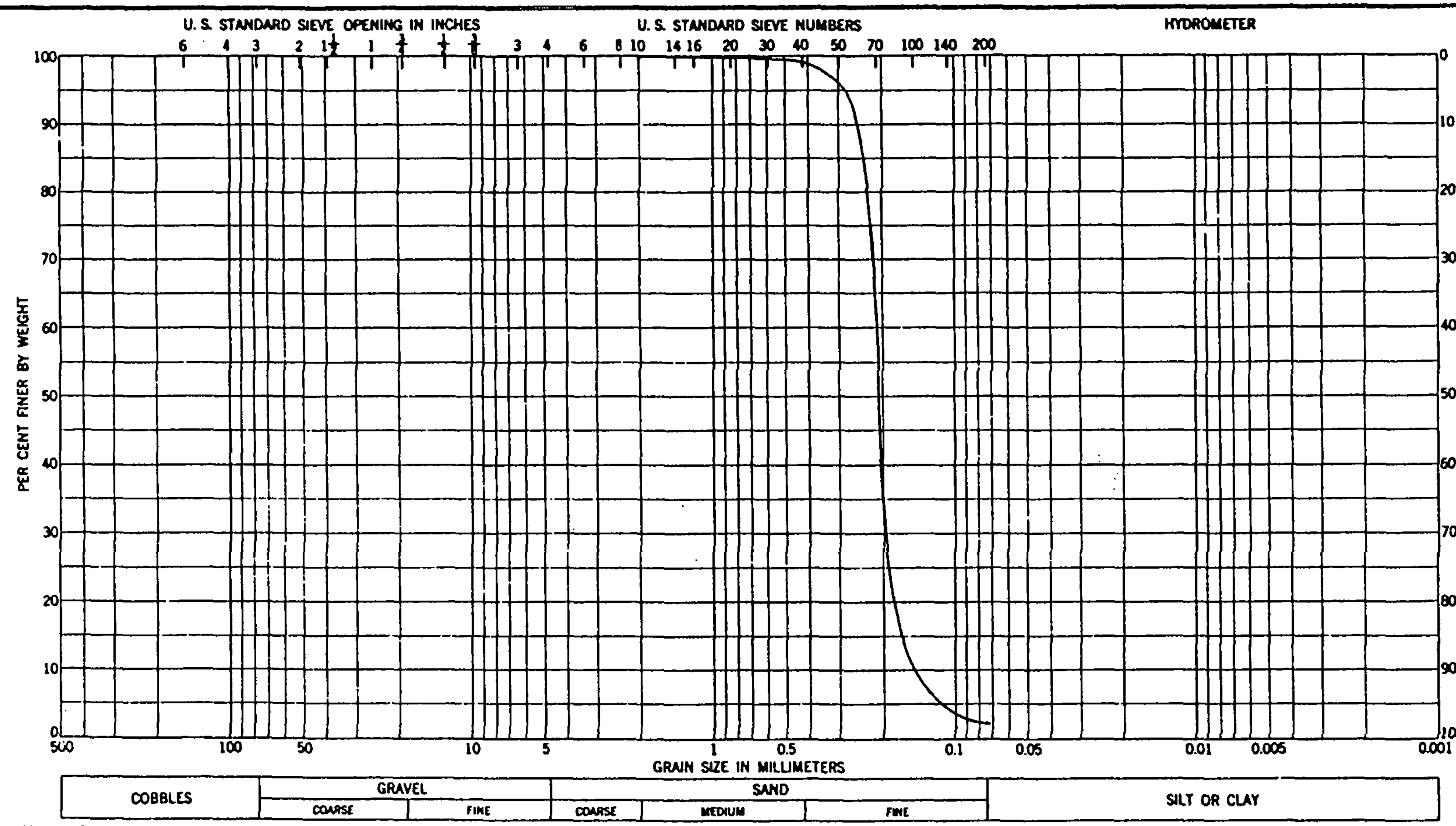
Job No. 84-075-4-002

Area

Boring No. D-87

Date

KANSAS CITY TESTING LABORATORY



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
SS-5	30.0-31.5					

GRADATION CURVES

Project Westlake

Job No. 84-075-4-00

Area

Boring No. S-88

Date

APPENDIX E

GROUNDWATER CHEMICAL ANALYSES

PRIORITY POLLUTANTS

DECEMBER, 1985

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report
Project: BURNS AND MCDONNELL Units: MCG/ML
Batch #: B-5120530

Customer ID: S-51 METALS
ETSRC ID: 5120530

Elm	Result
AG	<0.003
AL	<0.02
AS	<0.06
B	<0.05
BA	0.130
BE	<0.0003
BI	<0.06
CA	62.9
CD	<0.003
CO	<0.006
CR	<0.02
CU	0.01
FE	0.020
K	<0.4
LI	0.011
MG	19.9
MN	0.031
MO	<0.007
NA	4.79
NI	<0.02
P	<0.2
PB	<0.04
SB	<0.04
SE	<0.08
SI	8.56
SN	<0.02
SR	0.149
TI	<0.002
TL	<0.1
V	<0.003
ZN	1.24

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report
Project: BURNS AND MCDONNELL Units: MCG/ML
Batch #: B-5120530

Customer ID: I-59 METALS
ETSRC ID: 5120532

Elm	Result
AG	<0.003
AL	<0.02
AS	<0.06
B	1.2
BA	0.352
BE	<0.0003
BI	<0.06
CA	259.
CD	<0.003
CO	<0.006
CR	<0.02
CU	0.057
FE	7.38
K	7.4
LI	0.041
MG	63.3
MN	0.846
MO	<0.008
NA	138.
NI	0.03
P	0.3
PB	<0.04
SB	0.05
SE	<0.08
SI	12.6
SN	<0.02
SR	0.921
TI	<0.003
TL	<0.1
V	<0.003
ZN	0.11

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report
Project: BURNS AND MCDONNELL Units: MCG/ML
Batch #: B-5120530

Customer ID: S-80 METALS
ETSRC ID: 5120534

Elm	Result
AG	<0.003
AL	0.05
AS	<0.06
B	0.06
BA	0.238
BE	<0.0003
BI	<0.06
CA	132.
CD	<0.003
CO	<0.006
CR	<0.02
CU	0.019
FE	0.11
K	1.
LI	0.015
MG	36.7
MN	0.030
MO	<0.007
NA	82.8
NI	<0.02
P	0.4
PB	<0.04
SB	<0.04
SE	<0.08
SI	9.91
SN	<0.02
SR	0.389
TI	<0.002
TL	0.1
V	0.004
ZN	0.031

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report
Project: BURNS AND MCDONNELL Units: MCG/ML
Batch #: B-5120530

Customer ID: D-81 METALS
ETSRC ID: 5120535

Elm	Result
AG	<0.003
AL	0.086
AS	<0.06
B	0.18
BA	0.340
BE	<0.0003
BI	<0.06
CA	180.
CD	<0.003
CO	<0.006
CR	<0.02
CU	0.023
FE	0.14
K	1.5
LI	0.028
MG	38.0
MN	0.676
MO	0.02
NA	32.9
NI	<0.02
P	<0.2
PB	<0.04
SB	<0.04
SE	<0.08
SI	8.84
SN	<0.02
SR	0.455
TI	<0.003
TL	0.1
V	<0.003
ZN	0.087

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report
Project: BURNS AND MCDONNELL Units: MCG/ML
Batch #: B-5120530

Customer ID: S-82 METALS
ETSRC ID: 5120536

Elm	:	Result
AG	:	<0.003
AL	:	<0.02
AS	:	<0.06
B	:	1.3
BA	:	0.159
BE	:	<0.0003
BI	:	<0.06
CA	:	239.
CD	:	<0.003
CO	:	0.01
CR	:	<0.02
CU	:	0.040
FE	:	0.083
K	:	16.
LI	:	0.042
MG	:	59.6
MN	:	1.75
MO	:	<0.007
NA	:	137.
NI	:	0.060
P	:	0.3
PB	:	<0.04
SB	:	<0.05
SE	:	<0.08
SI	:	12.5
SN	:	<0.02
SR	:	0.805
TI	:	<0.003
TL	:	<0.1
V	:	0.003
ZN	:	0.099

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report

Project: BURNS AND MCDONNELL   Units: MCG/ML

Batch #: B-5120530

Customer ID: D-83 METALS
ETSRC ID: 5120537

Elm	Result
AG	<0.003
AL	<0.02
AS	<0.06
B	0.92
BA	1.15
BE	<0.0003
BI	<0.06
CA	158.
CD	<0.003
CO	<0.006
CR	<0.02
CU	<0.005
FE	0.386
K	13.
LI	0.033
MG	47.0
MN	0.419
MO	<0.007
NA	175.
NI	0.02
P	<0.2
PB	<0.04
SB	<0.04
SE	<0.08
SI	14.1
SN	<0.03
SR	0.714
TI	<0.003
TL	<0.1
V	<0.003
ZN	0.038

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report
Project: BURNS AND MCDONNELL Units: MCG/ML
Batch #: B-5120530

Customer ID: S-84 METALS
ETSRC ID: 5120538

Elm	:	Result
AG	:	<0.003
AL	:	0.52
AS	:	<0.06
B	:	0.1
BA	:	0.448
BE	:	<0.0003
BI	:	<0.06
CA	:	191.
CD	:	<0.003
CO	:	0.022
CR	:	<0.02
CU	:	0.007
FE	:	31.5
K	:	<0.4
LI	:	0.022
MG	:	49.2
MN	:	3.68
MO	:	<0.01
NA	:	29.1
NI	:	<0.02
P	:	<0.2
PB	:	<0.04
SB	:	0.05
SE	:	<0.09
SI	:	18.5
SN	:	<0.02
SR	:	0.494
TI	:	0.007
TL	:	<0.1
V	:	0.003
ZN	:	0.051

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report
Project: BURNS AND MCDONNELL Units: MCG/ML
Batch #: B-5120530

Customer ID: D-85 METALS
ETSRC ID: 5120539

Elm	Result
AG	0.003
AL	<0.02
AS	<0.06
B	0.23
BA	0.874
BE	<0.0003
BI	<0.06
CA	243.
CD	0.003
CO	0.01
CR	<0.02
CU	0.006
FE	14.3
K	<0.4
LI	0.030
MG	75.9
MN	1.87
MO	<0.008
NA	61.7
NI	<0.02
P	0.2
PB	<0.04
SB	0.06
SE	<0.09
SI	15.0
SN	<0.02
SR	0.522
TI	<0.003
TL	0.1
V	0.004
ZN	0.036

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report
Project: BURNS AND MCDONNELL Units: MCG/ML
Batch #: B-5120530

Customer ID: D-87 METALS
ETSRC ID: 5120540

Elm	Result
AG	<0.003
AL	<0.02
AS	<0.06
B	0.46
BA	0.702
BE	<0.0003
BI	<0.06
CA	273.
CD	<0.003
CO	<0.006
CR	<0.02
CU	<0.005
FE	7.67
K	<0.4
LI	0.034
MG	70.9
MN	1.19
MO	<0.008
NA	104.
NI	<0.02
P	<0.2
PB	<0.04
SB	<0.05
SE	<0.08
SI	15.2
SN	<0.03
SR	0.756
TI	<0.003
TL	<0.1
V	<0.003
ZN	0.018

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report
Project: BURNS AND MCDONNELL Units: MCG/ML
Batch #: B-5120530

Customer ID: S-88 METALS
ETSRC ID: 5120541

Elm	Result
AG	<0.003
AL	0.25
AS	<0.06
B	0.09
BA	0.199
BE	<0.0003
BI	<0.06
CA	247.
CD	<0.003
CO	0.01
CR	<0.02
CU	<0.005
FE	2.28
K	<0.4
LI	0.031
MG	56.0
MN	2.36
MO	<0.008
NA	10.1
NI	<0.02
P	0.2
PB	<0.04
SB	0.05
SE	<0.08
SI	14.4
SN	<0.02
SR	0.915
TI	0.004
TL	<0.1
V	0.003
ZN	0.051

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report
Project: BURNS AND MCDONNELL Units: MCG/ML
Batch #: B-5120530

Customer ID: D-89 METALS
ETSRC ID: 5120542

Elm	Result
AG	<0.003
AL	0.05
AS	<0.06
B	0.06
BA	0.191
BE	<0.0003
BI	<0.06
CA	129.
CD	<0.003
CO	<0.006
CR	<0.02
CU	0.033
FE	0.15
K	<0.4
LI	0.021
MG	50.9
MN	0.351
MO	<0.007
NA	10.9
NI	<0.02
P	<0.2
PB	<0.04
SB	<0.04
SE	<0.08
SI	10.7
SN	<0.02
SR	0.459
TI	<0.002
TL	<0.1
V	<0.003
ZN	0.048

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report
Project: BURNS AND MCDONNELL Units: MCG/ML
Batch #: B-5120530

Customer ID: D-90 METALS
ETSRC ID: 5120543

Elm	Result
AG	<0.003
AL	0.05
AS	<0.06
B	0.1
BA	0.174
BE	<0.0003
BI	<0.06
CA	70.0
CD	<0.003
CO	<0.006
CR	<0.02
CU	<0.005
FE	0.034
K	5.6
LI	0.025
MG	34.6
MN	0.14
MO	0.02
NA	45.6
NI	<0.02
P	<0.2
PB	<0.04
SB	<0.04
SE	<0.08
SI	11.1
SN	<0.02
SR	0.671
TI	<0.002
TL	<0.1
V	<0.003
ZN	<0.002

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report
Project: BURNS AND MCDONNELL Units: MCG/ML
Batch #: B-5120530

Customer ID: D-91 METALS
ETSRC ID: 5120544

Elm	:	Result
AG	:	<0.003
AL	:	0.03
AS	:	<0.06
B	:	0.07
BA	:	0.446
BE	:	<0.0003
BI	:	<0.06
CA	:	162.
CD	:	<0.003
CO	:	<0.006
CR	:	<0.02
CU	:	0.008
FE	:	4.04
K	:	<0.4
LI	:	0.026
MG	:	56.4
MN	:	1.09
MO	:	<0.008
NA	:	44.5
NI	:	<0.02
P	:	<0.2
PB	:	<0.04
SB	:	<0.05
SE	:	<0.08
SI	:	15.7
SN	:	<0.02
SR	:	0.826
TI	:	<0.003
TL	:	<0.1
V	:	<0.003
ZN	:	0.044

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report
Project: BURNS AND MCDONNELL Units: MCG/ML
Batch #: B-5120530

Customer ID: D-92 METALS
ETSRC ID: 5120545

Elm	:	Result
AG	:	<0.003
AL	:	0.20
AS	:	<0.06
B	:	0.21
BA	:	0.614
BE	:	<0.0003
BI	:	<0.06
CA	:	287.
CD	:	<0.003
CO	:	<0.006
CR	:	<0.02
CU	:	0.008
FE	:	6.28
K	:	1.8
LI	:	0.033
MG	:	77.5
MN	:	1.63
MO	:	<0.008
NA	:	153.
NI	:	0.02
P	:	0.3
PB	:	<0.04
SB	:	0.07
SE	:	<0.08
SI	:	11.1
SN	:	<0.03
SR	:	1.12
TI	:	0.20
TL	:	<0.1
V	:	<0.003
ZN	:	0.029

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report
Project: BURNS AND MCDONNELL Units: MCG/ML
Batch #: B-5120530

Customer ID: D-93 METALS
ETSRC ID: 5120546

Elm	Result
AG	0.004
AL	0.03
AS	<0.06
B	0.1
BA	1.06
BE	<0.0003
BI	<0.06
CA	246.
CD	<0.003
CO	<0.006
CR	<0.02
CU	0.024
FE	2.63
K	1.
LI	0.034
MG	61.4
MN	0.336
MO	<0.008
NA	64.3
NI	<0.02
P	0.2
PB	<0.04
SB	0.07
SE	<0.08
SI	14.5
SN	<0.03
SR	0.861
TI	<0.003
TL	<0.1
V	<0.003
ZN	0.020

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report
Project: BURNS AND MCDONNELL Units: MCG/ML
Batch #: B-5120530

Customer ID: D-94 METALS
ETSRC ID: 5120547

Elm	Result
AG	<0.003
AL	<0.02
AS	<0.06
B	0.06
BA	0.666
BE	<0.0003
BI	<0.06
CA	110.
CD	<0.003
CO	<0.006
CR	<0.02
CU	0.01
FE	0.12
K	3.1
LI	0.021
MG	24.6
MN	0.20
MO	0.01
NA	68.6
NI	<0.02
P	<0.2
PB	<0.04
SB	<0.04
SE	<0.08
SI	10.6
SN	<0.02
SR	0.588
TI	0.005
TL	<0.1
V	<0.003
ZN	0.14

Environmental Trace Substances Research Center
ICP Scan - Sample Analysis Report
Project: BURNS AND MCDONNELL Units: MCG/ML
Batch #: B-5120530

Customer ID: D-95 METALS
ETSRC ID: 5120548

Elm	Result
AG	<0.003
AL	0.04
AS	<0.06
B	0.1
BA	0.183
BE	<0.0003
BI	<0.06
CA	67.9
CD	<0.003
CO	<0.006
CR	<0.02
CU	0.01
FE	0.16
K	1.7
LI	0.013
MG	11.2
MN	0.066
MO	0.01
NA	40.9
NI	<0.02
P	0.3
PB	<0.04
SB	<0.04
SE	<0.08
SI	12.1
SN	<0.02
SR	0.325
TI	<0.003
TL	<0.1
V	<0.003
ZN	0.035

RESULT SUMMARY SHEETS

BASE/NEUTRAL PRIORITY POLLUTANTS

Environmental Trace Substances Research Center
Base Neutral Result Sheet
Detection Limit

Sample Source:
Submitter ID#:
ETSRC ID#: Data File#:
Sample Matrix:
Method: U.S.E.P.A. #625
Date Received:
Date Analyzed: Conc. Units: mcg/L
Analyst:

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Bis[2-Chloroethyl]ether	93				1.0
2. 1,3-Dichlorobenzene	146				1.0
3. 1,4-Dichlorobenzene	146				1.0
4. 1,2-Dichlorobenzene	146				1.0
5. Bis[2-Chlorophropyl]ether	45				5.0
6. Hexachloroethane	117				1.0
7. Nitrobenzene	77				1.0
8. Isophorone	82				2.0
9. Bis[2-Chloroethoxy]methane	93				3.0
10. Trichlorobenzene	180				1.0
11. Naphthalene	128				1.0
12. Hexachlorobutadiene	225				1.0
13. Hexachlorocyclopentadiene	237				1.0
14. 2-Chloronaphthalene	162				1.0
15. Acenaphthylene	152				1.0
17. Dimethylphthalate	163				1.0
18. Acenaphthene	154				1.0
19. 2,4-Dinitrotoluene	165				1.0
20. Fluorene	166				1.0
21. Diethylphthalate	149				1.0
22. N-Nitrosodiphenylamine	169				2.0
23. 4-Bromophenylphentyl ether	248				1.0

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
24.	Hexachlorobenzene	284				1.0
25.	Phenanthrene	178				1.0
26.	Anthracene	178				1.0
27.	Di-n-Butylphthalate	149				1.0
28.	Fluoranthene	202				1.0
29.	Pyrene	202				1.0
30.	Butylbenzylphthalate	149				1.0
31.	Benz[a]anthracene	228				1.0
32.	3,3'-Dichlorobenzidine	252				2.0
33.	Chrysene	228				1.0
34.	Bis[2-ethylhexyl]phthalate	149				1.0
35.	Di-n-Octylphthalate	149				1.0
36.	Benzo[b]Fluoranthene	252				1.0
37.	Benzo[k]Fluoranthene	252				1.0
38.	Benzo[a]Pyrene	252				1.0
39.	1,2-Diphenylhydrazine	77				5.0
40.	Benzidine	184				10.0
41.	4-Chlorophenyl phenyl ether	204				2.0
42.	N-Nitroso-n-propylamine	70				10.0

Environmental Trace Substances Research Center
Base Neutral Result Sheet

Sample Source: Burns & McDonnell
Submitter ID#: S-510R
ETSRC ID#: 5120513 Data File#: BN5120513
Sample Matrix: Water
Method: U.S.E.P.A. #625
Date Received: December 17, 1985
Date Analyzed: January 20, 1986 Conc. Units: mcg/L
Analyst: Carl Orazio

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Bis[2-Chloroethyl]ether	93				<MDL
2. 1,3-Dichlorobenzene	146				<MDL
3. 1,4-Dichlorobenzene	146				<MDL
4. 1,2-Dichlorobenzene	146				<MDL
5. Bis[2-Chlorophropyl]ether	45				<MDL
6. Hexachloroethane	117				<MDL
7. Nitrobenzene	77				<MDL
8. Isophorone	82				<MDL
9. Bis[2-Chloroethoxy]methane	93				<MDL
10. Trichlorobenzene	180				<MDL
11. Naphthalene	128				<MDL
12. Hexachlorobutadiene	225				<MDL
13. Hexachlorocyclopentadiene	237				<MDL
14. 2-Chloronaphthalene	162				<MDL
15. Acenaphthylene	152				<MDL
17. Dimethylphthalate	163				<MDL
18. Acenaphthene	154				<MDL
19. 2,4-Dinitrotoluene	165				<MDL
20. Fluorene	166				<MDL
21. Diethylphthalate	149				<MDL
22. N-Nitrodiphenylamine	169				<MDL
23. 4-Bromophenylphentyl ether	248				<MDL

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
24.	Hexachlorobenzene	284				<MDL
25.	Phenanthrene	178				<MDL
26.	Anthracene	178				<MDL
27.	Di-n-Butylphthalate	149				<MDL
28.	Fluoranthene	202				<MDL
29.	Pyrene	202				<MDL
30.	Butylbenzylphthalate	149				<MDL
31.	Benz[a]anthracene	228				<MDL
32.	3,3'-Dichlorobenzidine	252				<MDL
33.	Chrysene	228				<MDL
34.	Bis[2-ethylhexyl]phthalate	149				<MDL
35.	Di-n-Octylphthalate	149				<MDL
36.	Benzo[b]Fluoranthene	252				<MDL
37.	Benzo[k]Fluoranthene	252				<MDL
38.	Benzo[a]Pyrene	252				<MDL
39.	1,2-Diphenylhydrazine	77				<MDL
40.	Benzidine	184				<MDL
41.	4-Chlorophenyl phenyl ether	204				<MDL
42.	N-Nitroso-n-propylamine	70				

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188	2422	189204	101.5	100.0
2.	Chrysene D-12	240	3380	125099	149.1	100.0
3.						
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.	Trimethyl Cyclohexane-1-One	1079	No Match	123		
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

Environmental Trace Substances Research Center
Base Neutral Result Sheet

Sample Source: Burns & McDonnell
Submitter ID#: S-510R
ETSRC ID#: 5120513DR　　Data File#: BN0513DR
Sample Matrix: Water
Method: U.S.E.P.A. #625
Date Received: December 17, 1985
Date Analyzed: January 20, 1986　　Conc. Units: mcg/L
Analyst: Carl Orazio

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Bis[2-Chloroethyl]ether	93				<MDL
2. 1,3-Dichlorobenzene	146				<MDL
3. 1,4-Dichlorobenzene	146				<MDL
4. 1,2-Dichlorobenzene	146				<MDL
5. Bis[2-Chlorophropyl]ether	45				<MDL
6. Hexachloroethane	117				<MDL
7. Nitrobenzene	77				<MDL
8. Isophorone	82				<MDL
9. Bis[2-Chloroethoxy]methane	93				<MDL
10. Trichlorobenzene	180				<MDL
11. Naphthalene	128				<MDL
12. Hexachlorobutadiene	225				<MDL
13. Hexachlorocyclopentadiene	237				<MDL
14. 2-Chloronaphthalene	162				<MDL
15. Acenaphthylene	152				<MDL
17. Dimethylphthalate	163				<MDL
18. Acenaphthene	154				<MDL
19. 2,4-Dinitrotoluene	165				<MDL
20. Fluorene	166				<MDL
21. Diethylphthalate	149				<MDL
22. N-Nitrodiphenylamine	169				<MDL
23. 4-Bromophenylphentyl ether	248				<MDL

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
24.	Hexachlorobenzene	284				<MDL
25.	Phenanthrene	178				<MDL
26.	Anthracene	178				<MDL
27.	Di-n-Butylphthalate	149				<MDL
28.	Fluoranthene	202				<MDL
29.	Pyrene	202				<MDL
30.	Butylbenzylphthalate	149				<MDL
31.	Benz[a]anthracene	228				<MDL
32.	3,3'-Dichlorobenzidine	252				<MDL
33.	Chrysene	228				<MDL
34.	Bis[2-ethylhexyl]phthalate	149				<MDL
35.	Di-n-Octylphthalate	149				<MDL
36.	Benzo[b]Fluoranthene	252				<MDL
37.	Benzo[k]Fluoranthene	252				<MDL
38.	Benzo[a]Pyrene	252				<MDL
39.	1,2-Diphenylhydrazine	77				<MDL
40.	Benzidine	184				<MDL
41.	4-Chlorophenyl phenyl ether	204				<MDL
42.	N-Nitroso-n-propylamine	70				

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188	2424	141779	76.0	100.0
2.	Chrysene D-12	240	3384	105002	125.0	100.0
3.						
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.	Trimethyl Gyclohexen-1-one	1083	No Match	123		
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

Environmental Trace Substances Research Center
Base Neutral Result Sheet

Sample Source: Burns & McDonnell
Submitter ID#: I-590R
ETSRC ID#: 5120514 Data File#: BN5120514
Sample Matrix: Water
Method: U.S.E.P.A. #625
Date Received: December 17, 1985
Date Analyzed: January 20, 1986 Conc. Units: mcg/L
Analyst: Carl Orazio

Sample contained traces of aliphatic hydrocarbons. Possibly due to diesel or similar contaminant.

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Bis[2-Chloroethyl]ether	93				<MDL
2. 1,3-Dichlorobenzene	146				<MDL
3. 1,4-Dichlorobenzene	146				<MDL
4. 1,2-Dichlorobenzene	146				<MDL
5. Bis[2-Chlorophropyl]ether	45				<MDL
6. Hexachloroethane	117				<MDL
7. Nitrobenzene	77				<MDL
8. Isophorone	82				<MDL
9. Bis[2-Chloroethoxy]methane	93				<MDL
10. Trichlorobenzene	180				<MDL
11. Naphthalene	128				<MDL
12. Hexachlorobutadiene	225				<MDL
13. Hexachlorocyclopentadiene	237				<MDL
14. 2-Chloronaphthalene	162				<MDL
15. Acenaphthylene	152				<MDL
17. Dimethylphthalate	163				<MDL
18. Acenaphthene	154				<MDL
19. 2,4-Dinitrotoluene	165				<MDL
20. Fluorene	166				<MDL

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
21. Diethylphthalate	149				<MDL
22. N-Nitrodiphenylamine	169				<MDL
23. 4-Bromophenylphentyl ether	248				<MDL
24. Hexachlorobenzene	284				<MDL
25. Phenanthrene	178				<MDL
26. Anthracene	178				<MDL
27. Di-n-Butylphthalate	149				<MDL
28. Fluoranthene	202				<MDL
29. Pyrene	202				<MDL
30. Butylbenzylphthalate	149				<MDL
31. Benz[a]anthracene	228				<MDL
32. 3,3'-Dichlorobenzidine	252				<MDL
33. Chrysene	228				<MDL
34. Bis[2-ethylhexyl]phthalate	149	3463			*
35. Di-n-Octylphthalate	149				<MDL
36. Benzo[b]Fluoranthene	252				<MDL
37. Benzo[k]Fluoranthene	252				<MDL
38. Benzo[a]Pyrene	252				<MDL
39. 1,2-Diphenylhydrazine	77				<MDL
40. Benzidine	184				<MDL
41. 4-Chlorophenyl phenyl ether	204				<MDL
42. N-Nitroso-n-propylamine	70				<MDL

*Present but < quantitation limit.

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188	2427	160,353	86.0	100.0
2.	Chrysene D-12	240	3382	90,836	108.3	100.0
3.						
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.	1,1'-Oxy Bis (2 Ethoxy) Ethane	1031	946	59		
2.	Pentylenetetrazole	2053	973	55		
		1630	No Match			
3.	Aliphatic Hydrocarbon	3509	No Match	57		
4.	Aliphatic Hydrocarbon	3626	No Match	57		
5.						
6.						
7.						
8.						
9.						
10.						

Environmental Trace Substances Research Center

Base Neutral Result Sheet

Sample Source: Burns & McDonnell

Submitter ID#: S-800R

ETSRC ID#: 5120515 Data File#: BN5120515

Sample Matrix: Water

Method: U.S.E.P.A. #625

Date Received: December 17, 1985

Date Analyzed: January 20, 1986 Conc. Units: mcg/L

Analyst: Carl Orazio

Sample contains traces of aliphatic hydrocarbons from diesel or similar contaminants.

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1.	Bis[2-Chloroethyl]ether	93				<MDL
2.	1,3-Dichlorobenzene	146				<MDL
3.	1,4-Dichlorobenzene	146				<MDL
4.	1,2-Dichlorobenzene	146				<MDL
5.	Bis[2-Chlorophropyl]ether	45				<MDL
6.	Hexachloroethane	117				<MDL
7.	Nitrobenzene	77				<MDL
8.	Isophorone	82				<MDL
9.	Bis[2-Chloroethoxy]methane	93				<MDL
10.	Trichlorobenzene	180				<MDL
11.	Naphthalene	128				<MDL
12.	Hexachlorobutadiene	225				<MDL
13.	Hexachlorocyclopentadiene	237				<MDL
14.	2-Chloronapnthalene	162				<MDL
15.	Acenaphthylene	152				<MDL
17.	Dimethylphthalate	163				<MDL
18.	Acenaphthene	154				<MDL
19.	2,4-Dinitrotoluene	165				<MDL
20.	Fluorene	166				<MDL

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
21.	Diethylphthalate	149				<MDL
22.	N-Nitrodiphenylamine	169				<MDL
23.	4-Bromophenylphentyl ether	248				<MDL
24.	Hexachlorobenzene	284				<MDL
25.	Phenanthrene	178				<MDL
26.	Anthracene	178				<MDL
27.	Di-n-Butylphthalate	149				<MDL
28.	Fluoranthene	202				<MDL
29.	Pyrene	202				<MDL
30.	Butylbenzylphthalate	149				<MDL
31.	Benz[a]anthracene	228				<MDL
32.	3,3'-Dichlorobenzidine	252				<MDL
33.	Chrysene	228	3463			<MDL
34.	Bis[2-ethylhexyl]phthalate	149				<MDL
35.	Di-n-Octylphthalate	149				<MDL
36.	Benzo[b]Fluoranthene	252				<MDL
37.	Benzo[k]Fluoranthene	252				<MDL
38.	Benzo[a]Pyrene	252				<MDL
39.	1,2-Diphenylhydrazine	77				<MDL
40.	Benzidine	184				<MDL
41.	4-Chlorophenyl phenyl ether	204				<MDL
42.	N-Nitroso-n-propylamine	70				<MDL

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188	2426	142,258	76.3	100.0
2.	Chrysene D-12	240	3384	100,922	120.3	100.0
3.						
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.	Aliphatic Hydrocarbon	3150				
2.	Aliphatic Hydrocarbon	3626				
3.	Trimethyl Cyclohexane-1-One	1082	No Match			
4.						
5.						
6.						
7.						
8.						
9.						
10.						

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188	2419	116205	106.3	100.0
2.	Chrysene D-12	240	3374	84859	110.2	100.0
3.						
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.	Trimethyl Benzene	816	986	105		
2.	Triethyl Phosphate	1129	938			
3.	Ethyl Benzyl Alcohol	1044				
4.	2 Naphthylamine	2006				
5.	Sulfur	2828				
6.						
7.						
8.						
9.						
10.						

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
24.	Hexachlorobenzene	284				<MDL
25.	Phenanthrene	178				<MDL
26.	Anthracene	178				<MDL
27.	Di-n-Butylphthalate	149				<MDL
28.	Fluoranthene	202				<MDL
29.	Pyrene	202				<MDL
30.	Butylbenzylphthalate	149				<MDL
31.	Benz[a]anthracene	228				<MDL
32.	3,3'-Dichlorobenzidine	252				<MDL
33.	Chrysene	228				<MDL
34.	Bis[2-ethylhexyl]phthalate	149	3453	2940	1.84	1.74
35.	Di-n-Octylphthalate	149				<MDL
36.	Benzo[b]Fluoranthene	252				<MDL
37.	Benzo[k]Fluoranthene	252				<MDL
38.	Benzo[a]Pyrene	252				<MDL
39.	1,2-Diphenylhydrazine	77				<MDL
40.	Benzidine	184				<MDL
41.	4-Chlorophenyl phenyl ether	204				<MDL
42.	N-Nitroso-n-propylamine	70				<MDL

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
24. Hexachlorobenzene	284				<MDL
25. Phenanthrene	178				<MDL
26. Anthracene	178				<MDL
27. Di-n-Butylphthalate	149				<MDL
28. Fluoranthene	202				<MDL
29. Pyrene	202				<MDL
30. Butylbenzylphthalate	149				<MDL
31. Benz[a]anthracene	228				<MDL
32. 3,3'-Dichlorobenzidine	252				<MDL
33. Chrysene	228				<MDL
34. Bis[2-ethylhexyl]phthalate	149			1.1	0.96
35. Di-n-Octylphthalate	149				<MDL
36. Benzo[b]Fluoranthene	252				<MDL
37. Benzo[k]Fluoranthene	252				<MDL
38. Benzo[a]Pyrene	252				<MDL
39. 1,2-Diphenylhydrazine	77				<MDL
40. Benzidine	184				<MDL
41. 4-Chlorophenyl phenyl ether	204				<MDL
42. N-Nitroso-n-propylamine	70				<MDL

Environmental Trace Substances Research Center

Base Neutral Result Sheet

Sample Source: Burns & McDonnell

Submitter ID#: D-85 OR

ETSRC ID#: 5120520 Data File#: BN5120520

Sample Matrix: Water

Method: U.S.E.P.A. #625

Date Received: December 17, 1985

Date Analyzed: January 21, 1986 Conc. Units: mcg/L

Analyst: Carl Orazio

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Bis[2-Chloroethyl]ether	93				<MDL
2. 1,3-Dichlorobenzene	146				<MDL
3. 1,4-Dichlorobenzene	146				<MDL
4. 1,2-Dichlorobenzene	146				<MDL
5. Bis[2-Chlorophropyl]ether	45				<MDL
6. Hexachloroethane	117				<MDL
7. Nitrobenzene	77				<MDL
8. Isophorone	82				<MDL
9. Bis[2-Chloroethoxy]methane	93				<MDL
10. Trichlorobenzene	180				<MDL
11. Naphthalene	128				<MDL
12. Hexachlorobutadiene	225				<MDL
13. Hexachlorocyclopentadiene	237				<MDL
14. 2-Chloronaphthalene	162				<MDL
15. Acenaphthylene	152				<MDL
17. Dimethylphthalate	163				<MDL
18. Acenaphthene	154				<MDL
19. 2,4-Dinitrotoluene	165				<MDL
20. Fluorene	166				<MDL
21. Diethylphthalate	149				<MDL
22. N-Nitrodiphenylamine	169				<MDL
23. 4-Bromophenylphentyl ether	248				<MDL

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
24.	Hexachlorobenzene	284				<MDL
25.	Phenanthrene	178				<MDL
26.	Anthracene	178				<MDL
27.	Di-n-Butylphthalate	149				<MDL
28.	Fluoranthene	202				<MDL
29.	Pyrene	202				<MDL
30.	Butylbenzylphthalate	149				<MDL
31.	Benz[a]anthracene	228				<MDL
32.	3,3'-Dichlorobenzidine	252				<MDL
33.	Chrysene	228				<MDL
34.	Bis[2-ethylhexyl]phthalate	149	3456	94122	129.5	115.2
35.	Di-n-Octylphthalate	149				<MDL
36.	Benzo[b]Fluoranthene	252				<MDL
37.	Benzo[k]Fluoranthene	252				<MDL
38.	Benzo[a]Pyrene	252				<MDL
39.	1,2-Diphenylhydrazine	77				<MDL
40.	Benzidine	184				<MDL
41.	4-Chlorophenyl phenyl ether	204				<MDL
42.	N-Nitroso-n-propylamine	70				<MDL

Environmental Trace Substances Research Center
Base Neutral Result Sheet

Sample Source: Burns & McDonnell
Submitter ID#: D-900R
ETSRC ID#: 5120524 Data File#: BN5120524
Sample Matrix: Water
Method: U.S.E.P.A. #625
Date Received: December 17, 1985
Date Analyzed: January 22, 1985 Conc. Units: mcg/L
Analyst: Carl Orazio

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Bis[2-Chloroethyl]ether	93				<MDL
2. 1,3-Dichlorobenzene	146				<MDL
3. 1,4-Dichlorobenzene	146				<MDL
4. 1,2-Dichlorobenzene	146				<MDL
5. Bis[2-Chlorophropyl]ether	45				<MDL
6. Hexachloroethane	117				<MDL
7. Nitrobenzene	77				<MDL
8. Isophorone	82				<MDL
9. Bis[2-Chloroethoxy]methane	93				<MDL
10. Trichlorobenzene	180				<MDL
11. Naphthalene	128				<MDL
12. Hexachlorobutadiene	225				<MDL
13. Hexachlorocyclopentadiene	237				<MDL
14. 2-Chloronaphthalene	162				<MDL
15. Acenaphthylene	152				<MDL
17. Dimethylphthalate	163				<MDL
18. Acenaphthene	154				<MDL
19. 2,4-Dinitrotoluene	165				<MDL
20. Fluorene	166				<MDL
21. Diethylphthalate	149				<MDL
22. N-Nitrodiphenylamine	169				<MDL
23. 4-Bromophenylphentyl ether	248				<MDL

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188	2421	120,607	100.5	100.0
2.	Chrysene D-12	240	3379	90,290	92.5	100.0
3.	Phenol D-5	99	783	12,775		
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.		1079	No Match	123		
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
24. Hexachlorobenzene	284				<MDL
25. Phenanthrene	178				<MDL
26. Anthracene	178				<MDL
27. Di-n-Butylphthalate	149				<MDL
28. Fluoranthene	202				<MDL
29. Pyrene	202				<MDL
30. Butylbenzylphthalate	149				<MDL
31. Benz[a]anthracene	228				<MDL
32. 3,3'-Dichlorobenzidine	252				<MDL
33. Chrysene	228				<MDL
34. Bis[2-ethylhexyl]phthalate	149				<MDL
35. Di-n-Octylphthalate	149				<MDL
36. Benzo[b]Fluoranthene	252				<MDL
37. Benzo[k]Fluoranthene	252				<MDL
38. Benzo[a]Pyrene	252				<MDL
39. 1,2-Diphenylhydrazine	77				<MDL
40. Benzidine	184				<MDL
41. 4-Chlorophenyl phenyl etner	204				<MDL
42. N-Nitroso-n-propylamine	70				

Environmental Trace Substances Research Center
Base Neutral Result Sheet

Sample Source: Burns & McDonnell
Submitter ID#: D-890R
ETSRC ID#: 5120523 Data File#: BN5120523
Sample Matrix: Water
Method: U.S.E.P.A. #625
Date Received: December 17, 1985
Date Analyzed: January 20, 1986 Conc. Units: mcg/L
Analyst: Carl Orazio

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Bis[2-Chloroethyl]ether	93				<MDL
2. 1,3-Dichlorobenzene	146				<MDL
3. 1,4-Dichlorobenzene	146				<MDL
4. 1,2-Dichlorobenzene	146				<MDL
5. Bis[2-Chlorophropyl]ether	45				<MDL
6. Hexachloroethane	117				<MDL
7. Nitrobenzene	77				<MDL
8. Isophorone	82				<MDL
9. Bis[2-Chloroethoxy]methane	93				<MDL
10. Trichlorobenzene	180				<MDL
11. Naphthalene	128				<MDL
12. Hexachlorobutadiene	225				<MDL
13. Hexachlorocyclopentadiene	237				<MDL
14. 2-Chloronaphthalene	162				<MDL
15. Acenaphthylene	152				<MDL
17. Dimethylphthalate	163				<MDL
18. Acenaphthene	154				<MDL
19. 2,4-Dinitrotoluene	165				<MDL
20. Fluorene	166				<MDL
21. Diethylphthalate	149				<MDL
22. N-Nitrodiphenylamine	169				<MDL
23. 4-Bromophenylphentyl ether	248				<MDL

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188	2425	101,792	84.8	100.0
2.	Chrysene D-12	240	3381	89,410	91.6	100.0
3.						
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
22. N-Nitrodiphenylamine	169				<MDL
23. 4-Bromophenylphentyl ether	248				<MDL
24. Hexachlorobenzene	284				<MDL
25. Phenanthrene	178				<MDL
26. Anthracene	178				<MDL
27. Di-n-Butylphthalate	149				<MDL
28. Fluoranthene	202				<MDL
29. Pyrene	202				<MDL
30. Butylbenzylphthalate	149				<MDL
31. Benz[a]anthracene	228				<MDL
32. 3,3'-Dichlorobenzidine	252				<MDL
33. Chrysene	228				<MDL
34. Bis[2-ethylhexyl]phthalate	149	3440	8084	6.6	7.4
35. Di-n-Octylphthalate	149	3679	15452	7.8	6.4
36. Benzo[b]Fluoranthene	252				<MDL
37. Benzo[k]Fluoranthene	252				<MDL
38. Benzo[a]Pyrene	252				<MDL
39. 1,2-Diphenylhydrazine	77				<MDL
40. Benzidine	184				<MDL
41. 4-Chlorophenyl phenyl ether	204				<MDL
42. N-Nitroso-n-propylamine	70				<MDL

Environmental Trace Substances Research Center
Base Neutral Result Sheet

Sample Source: Burns & McDonnell
Submitter ID#: D-930R
ETSRC ID#: 5120527
Data File#: BN512527
Sample Matrix: Water
Method: U.S.E.P.A. #625
Date Received: December 17, 1985
Date Analyzed: January 23, 1986
Conc. Units: mcg/L
Analyst: Carl Orazio

Contaminated with phthlate esters.

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1.	Bis[2-Chloroethyl]ether	93				<MDL
2.	1,3-Dichlorobenzene	146				<MDL
3.	1,4-Dichlorobenzene	146				<MDL
4.	1,2-Dichlorobenzene	146				<MDL
5.	Bis[2-Chlorophropyl]ether	45				<MDL
6.	Hexachloroethane	117				<MDL
7.	Nitrobenzene	77				<MDL
8.	Isophorone	82				<MDL
9.	Bis[2-Chloroethoxy]methane	93				<MDL
10.	Trichlorobenzene	180				<MDL
11.	Naphthalene	128				<MDL
12.	Hexachlorobutadiene	225				<MDL
13.	Hexachlorocyclopentadiene	237				<MDL
14.	2-Chloronaphthalene	162				<MDL
15.	Acenaphthylene	152				<MDL
17.	Dimethylphthalate	163				<MDL
18.	Acenaphthene	154				<MDL
19.	2,4-Dinitrotoluene	165				<MDL
20.	Fluorene	166				<MDL
21.	Diethylphthalate	149				<MDL

Environmental Trace Substances Research Center

Base Neutral Result Sheet

Sample Source: Burns & McDonnell

Submitter ID#: D- 91 OR

ETSRC ID#: 5120525 Data File#: 512052BN

Sample Matrix: Water

Method: U.S.E.P.A. #625

Date Received: December 17, 1985

Date Analyzed: March 4, 1986 Conc. Units: mcg/L

Analyst: Carl Orazio

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Bis[2-Chloroethyl]ether	93				<MDL
2. 1,3-Dichlorobenzene	146				<MDL
3. 1,4-Dichlorobenzene	146				<MDL
4. 1,2-Dichlorobenzene	146				<MDL
5. Bis[2-Chlorophropyl]ether	45				<MDL
6. Hexachloroethane	117				<MDL
7. Nitrobenzene	77				<MDL
8. Isophorone	82				<MDL
9. Bis[2-Chloroethoxy]methane	93				<MDL
10. Trichlorobenzene	180				<MDL
11. Naphthalene	128				<MDL
12. Hexachlorobutadiene	225				<MDL
13. Hexachlorocyclopentadiene	237				<MDL
14. 2-Chloronaphthalene	162				<MDL
15. Acenaphthylene	152				<MDL
17. Dimethylphthalate	163				<MDL
18. Acenaphthene	154				<MDL
19. 2,4-Dinitrotoluene	165				<MDL
20. Fluorene	166				<MDL
21. Diethylphthalate	149				<MDL
22. N-Nitrodiphenylamine	169				<MDL
23. 4-Bromophenylphentyl ether	248				<MDL

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188	2416	147,856	122.0	100.0
2.	Chrysene D-12	240	3376	141,120	137.0	100.0
3.						
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.	Fatty Acid Octy Ester	2057	966	119		
2.		3271	973	129		
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188	2388	29701	22.4	20.0
2.	Chrysene D-12	240	3336	123162	15.9	20.0
3.						
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
24. Hexachlorobenzene	284				<MDL
25. Phenanthrene	178				<MDL
26. Anthracene	178				<MDL
27. Di-n-Butylphthalate	149				<MDL
28. Fluoranthene	202				<MDL
29. Pyrene	202				<MDL
30. Butylbenzylphthalate	149				<MDL
31. Benz[a]anthracene	228				<MDL
32. 3,3'-Dichlorobenzidine	252				<MDL
33. Chrysene	228				<MDL
34. Bis[2-ethylhexyl]phthalate	149				<MDL
35. Di-n-Octylphthalate	149				<MDL
36. Benzo[b]Fluoranthene	252				<MDL
37. Benzo[k]Fluoranthene	252				<MDL
38. Benzo[a]Pyrene	252				<MDL
39. 1,2-Diphenylhydrazine	77				<MDL
40. Benzidine	184				<MDL
41. 4-Chlorophenyl phenyl ether	204				<MDL
42. N-Nitroso-n-propylamine	70				

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
24. Hexachlorobenzene	284				<MDL
25. Phenanthrene	178				<MDL
26. Anthracene	178				<MDL
27. Di-n-Butylphthalate	149				<MDL
28. Fluoranthene	202				<MDL
29. Pyrene	202				<MDL
30. Butylbenzylphthalate	149				<MDL
31. Benz[a]anthracene	228				<MDL
32. 3,3'-Dichlorobenzidine	252				<MDL
33. Chrysene	228				<MDL
34. Bis[2-ethylhexyl]phthalate	149				<MDL
35. Di-n-Octylphthalate	149				<MDL
36. Benzo[b]Fluoranthene	252				<MDL
37. Benzo[k]Fluoranthene	252				<MDL
38. Benzo[a]Pyrene	252				<MDL
39. 1,2-Diphenylhydrazine	77				<MDL
40. Benzidine	184				<MDL
41. 4-Chlorophenyl phenyl ether	204				<MDL
42. N-Nitroso-n-propylamine	70				

Environmental Trace Substances Research Center

Base Neutral Result Sheet

Sample Source: Burns & McDonnell

Submitter ID#: D-910R

ETSRC ID#: 5120525D   Data File#: BN5120525D

Sample Matrix: Water

Method: U.S.E.P.A. #625

Date Received: December 17, 1985

Date Analyzed: January 22, 1986   Conc. Units: mcg/L

Analyst: Carl Orazio

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Bis[2-Chloroethyl]ether	93				<MDL
2. 1,3-Dichlorobenzene	146				<MDL
3. 1,4-Dichlorobenzene	146				<MDL
4. 1,2-Dichlorobenzene	146				<MDL
5. Bis[2-Chlorophropyl]ether	45				<MDL
6. Hexachloroethane	117				<MDL
7. Nitrobenzene	77				<MDL
8. Isophorone	82				<MDL
9. Bis[2-Chloroethoxy]methane	93				<MDL
10. Trichlorobenzene	180				<MDL
11. Naphthalene	128				<MDL
12. Hexachlorobutadiene	225				<MDL
13. Hexachlorocyclopentadiene	237				<MDL
14. 2-Chloronaphthalene	162				<MDL
15. Acenaphthylene	152				<MDL
17. Dimethylphthalate	163				<MDL
18. Acenaphthene	154				<MDL
19. 2,4-Dinitrotoluene	165				<MDL
20. Fluorene	166				<MDL
21. Diethylphthalate	149				<MDL
22. N-Nitrodiphenylamine	169				<MDL
23. 4-Bromophenylphentyl ether	248				<MDL

Environmental Trace Substances Research Center

Base Neutral Result Sheet

Sample Source: Burns & McDonnell

Submitter ID#: S- 84 OR

ETSRC ID#: 5120519 Data File#: BN5120519

Sample Matrix: Water

Method: U.S.E.P.A. #625

Date Received: December 17, 1985

Date Analyzed: January 21, 1986 Conc. Units: mcg/L

Analyst: Carl Orazio

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1.	Bis[2-Chloroethyl]ether	93				<MDL
2.	1,3-Dichlorobenzene	146				<MDL
3.	1,4-Dichlorobenzene	146				<MDL
4.	1,2-Dichlorobenzene	146				<MDL
5.	Bis[2-Chlorophropyl]ether	45				<MDL
6.	Hexachloroethane	117				<MDL
7.	Nitrobenzene	77				<MDL
8.	Isophorone	82				<MDL
9.	Bis[2-Chloroethoxy]methane	93				<MDL
10.	Trichlorobenzene	180				<MDL
11.	Naphthalene	128				<MDL
12.	Hexachlorobutadiene	225				<MDL
13.	Hexachlorocyclopentadiene	237				<MDL
14.	2-Chloronapnthalene	162				<MDL
15.	Acenaphthylene	152				<MDL
17.	Dimethylphthalate	163				<MDL
18.	Acenaphthene	154				<MDL
19.	2,4-Dinitrotoluene	165				<MDL
20.	Fluorene	166				<MDL
21.	Diethylphthalate	149				<MDL
22.	N-Nitrodiphenylamine	169				<MDL
23.	4-Bromophenylphentyl ether	248				<MDL

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188	2424	131211	109.3	100.0
2.	Chrysene D-12	240	3382	114619	117.5	100.0
3.						
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.	1,1' Ethane Bis Oxy(Ethoxy)	1039		46		
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

sc#25120518/

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
24.	Hexachlorobenzene	284				<MDL
25.	Phenanthrene	178				<MDL
26.	Anthracene	178				<MDL
27.	Di-n-Butylphthalate	149	2684	599	0.31	0.35
28.	Fluoranthene	202				<MDL
29.	Pyrene	202				<MDL
30.	Butylbenzylphthalate	149				<MDL
31.	Benz[a]anthracene	228				<MDL
32.	3,3'-Dichlorobenzidine	252				<MDL
33.	Chrysene	228				<MDL
34.	Bis[2-ethylhexyl]phthalate	149				<MDL
35.	Di-n-Octylphthalate	149	3683	2247	0.94	0.97
36.	Benzo[b]Fluoranthene	252				<MDL
37.	Benzo[k]Fluoranthene	252				<MDL
38.	Benzo[a]Pyrene	252				<MDL
39.	1,2-Diphenylhydrazine	77				<MDL
40.	Benzidine	184				<MDL
41.	4-Chlorophenyl phenyl ether	204				<MDL
42.	N-Nitroso-n-propylamine	70				<MDL

Environmental Trace Substances Research Center
Base Neutral Result Sheet

Sample Source: Burns & McDonnell
Submitter ID#: S- 88 DR
ETSRC ID#: 5120522 Data File#: BN5120522
Sample Matrix: Water
Method: U.S.E.P.A. #625
Date Received: January
Date Analyzed: January 23, 1986 Conc. Units: mcg/L
Analyst: Carl Orazio

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Bis[2-Chloroethyl]ether	93				<MDL
2. 1,3-Dichlorobenzene	146				<MDL
3. 1,4-Dichlorobenzene	146				<MDL
4. 1,2-Dichlorobenzene	146				<MDL
5. Bis[2-Chlorophropyl]ether	45				<MDL
6. Hexachloroethane	117				<MDL
7. Nitrobenzene	77				<MDL
8. Isophorone	82				<MDL
9. Bis[2-Chloroethoxy]methane	93				<MDL
10. Trichlorobenzene	180				<MDL
11. Naphthalene	128				<MDL
12. Hexachlorobutadiene	225				<MDL
13. Hexachlorocyclopentadiene	237				<MDL
14. 2-Chloronaphthalene	162				<MDL
15. Acenaphtnylene	152				<MDL
17. Dimetnylphthalate	163				<MDL
18. Acenaphthene	154				<MDL
19. 2,4-Dinitrotoluene	165				<MDL
20. Fluorene	166				<MDL
21. Diethylphthalate	149				<MDL
22. N-Nitrodiphenylamine	169				<MDL
23. 4-Bromophenylphentyl ether	248				<MDL

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188	3415	134,442	115.3	100.0
2.	Chrysene D-12	240	a3372	121,484	118.6	100.0
3.						
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.	Ethane, 1,1'-Oxy Bis[2]Ethoxy	1029	924	59		
2.	Trimethyl Cyclohexan-1-One	1078	No Match	123		
3.	Triethy Phosphate	1126	936	99		
4.	Hexane Dioic Acid, Dioctylester	3264	966	129		
5.						
6.						
7.						
8.						
9.						
10.						

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
24.	Hexachlorobenzene	284				<MDL
25.	Phenanthrene	178				<MDL
26.	Anthracene	178				<MDL
27.	Di-n-Butylphthalate	149	2675	1321	0.81	0.70
28.	Fluoranthene	202				<MDL
29.	Pyrene	202				<MDL
30.	Butylbenzylphthalate	149				<MDL
31.	Benz[a]anthracene	228				<MDL
32.	3,3'-Dichlorobenzidine	252				<MDL
33.	Chrysene	228				<MDL
34.	Bis[2-ethylhexyl]phthalate	149	3460	671,459	549.4	477.4
35.	Di-n-Octylphthalate	149	3672	5971	3.0	2.6
36.	Benzo[b]Fluoranthene	252				<MDL
37.	Benzo[k]Fluoranthene	252				<MDL
38.	Benzo[a]Pyrene	252				<MDL
39.	1,2-Diphenylhydrazine	77				<MDL
40.	Benzidine	184				<MDL
41.	4-Chlorophenyl phenyl ether	204				<MDL
42.	N-Nitroso-n-propylamine	70				<MDL

Environmental Trace Substances Research Center

Base Neutral Result Sheet

Sample Source: Burns & McDonnell

Submitter ID#: D-92 OR

ETSRC ID#: 5120526 Data File#. BN5120526

Sample Matrix: Water

Method: U.S.E.P.A. #625

Date Received: December 17, 1985

Date Analyzed: January 23, 1986 Conc. Units: mcg/L

Analyst: Carl Orazio

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Bis[2-Chloroethyl]ether	93				<MDL
2. 1,3-Dichlorobenzene	146				<MDL
3. 1,4-Dichlorobenzene	146				<MDL
4. 1,2-Dichlorobenzene	146				<MDL
5. Bis[2-Chlorophropyl]ether	45				<MDL
6. Hexachloroethane	117				<MDL
7. Nitrobenzene	77				<MDL
8. Isophorone	82				<MDL
9. Bis[2-Chloroethoxy]methane	93				<MDL
10. Trichlorobenzene	180				<MDL
11. Naphthalene	128				<MDL
12. Hexachlorobutadiene	225				<MDL
13. Hexachlorocyclopentadiene	237				<MDL
14. 2-Chloronaphthalene	162				<MDL
15. Acenaphthylene	152				<MDL
17. Dimethylphthalate	163				<MDL
18. Acenaphthene	154				<MDL
19. 2,4-Dinitrotoluene	165				<MDL
20. Fluorene	166				<MDL
21. Diethylphthalate	149				<MDL
22. N-Nitrodiphenylamine	169				<MDL
23. 4-Bromophenylphentyl ether	248				<MDL

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188	2414	120131	99.0	100.0
2.	Chrysene D-12	240	3373	110619	108.0	100.0
3.						
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.	Trimethyl Cyclohexene-1-one	1074	No Match	123		
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
24. Hexachlorobenzene	284				<MDL
25. Phenanthrene	178				<MDL
26. Anthracene	178				<MDL
27. Di-n-Butylphthalate	149				<MDL
28. Fluoranthene	202				<MDL
29. Pyrene	202				<MDL
30. Butylbenzylphthalate	149				<MDL
31. Benz[a]anthracene	228				<MDL
32. 3,3'-Dichlorobenzidine	252				<MDL
33. Chrysene	228				<MDL
34. Bis[2-ethylhexyl]phthalate	149				<MDL
35. Di-n-Octylphthalate	149				<MDL
36. Benzo[b]Fluoranthene	252				<MDL
37. Benzo[k]Fluoranthene	252				<MDL
38. Benzo[a]Pyrene	252				<MDL
39. 1,2-Diphenylhydrazine	77				<MDL
40. Benzidine	184				<MDL
41. 4-Chlorophenyl phenyl ether	204				<MDL
42. N-Nitroso-n-propylamine	70				

Environmental Trace Substances Research Center
Base Neutral Result Sheet

Sample Source: Burns & McDonnell
Submitter ID#: D-83 OR
ETSRC ID#: 5120518 Data File#: BN5120518
Sample Matrix: Water
Method: U.S.E.P.A. #625
Date Received: December 17, 1985
Date Analyzed: January 21, 1986 Conc. Units: mcg/L
Analyst: Carl Orazio

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Bis[2-Chloroethyl]ether	93				<MDL
2. 1,3-Dichlorobenzene	146				<MDL
3. 1,4-Dichlorobenzene	146				<MDL
4. 1,2-Dichlorobenzene	146				<MDL
5. Bis[2-Chlorophropyl]ether	45				<MDL
6. Hexachloroethane	117				<MDL
7. Nitrobenzene	77				<MDL
8. Isophorone	82				<MDL
9. Bis[2-Chloroethoxy]methane	93				<MDL
10. Trichlorobenzene	180				<MDL
11. Naphthalene	128				<MDL
12. Hexachlorobutadiene	225				<MDL
13. Hexachlorocyclopentadiene	237				<MDL
14. 2-Chloronaphthalene	162				<MDL
15. Acenaphthylene	152				<MDL
17. Dimethylphthalate	163				<MDL
18. Acenaphthene	154				<MDL
19. 2,4-Dinitrotoluene	165				<MDL
20. Fluorene	166				<MDL
21. Diethylphthalate	149				<MDL
22. N-Nitrodiphenylamine	169				<MDL
23. 4-Bromophenylphentyl ether	248				<MDL

Environmental Trace Substances Research Center

Base Neutral Result Sheet

Sample Source: Burns & McDonnell

Submitter ID#: S-820R

ETSRC ID#: 5120517 Data File#: BN5120517

Sample Matrix: Water

Method: U.S.E.P.A. #625

Date Received: December 17, 1985

Date Analyzed: January 20, 1986 Conc. Units: mcg/L

Analyst: Carl Orazio

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Bis[2-Chloroethyl]ether	93				<MDL
2. 1,3-Dichlorobenzene	146				<MDL
3. 1,4-Dichlorobenzene	146				<MDL
4. 1,2-Dichlorobenzene	146				<MDL
5. Bis[2-Chlorophropyl]ether	45				<MDL
6. Hexachloroethane	117				<MDL
7. Nitrobenzene	77				<MDL
8. Isophorone	82				<MDL
9. Bis[2-Chloroethoxy]methane	93				<MDL
10. Trichlorobenzene	180				<MDL
11. Naphthalene	128				<MDL
12. Hexachlorobutadiene	225				<MDL
13. Hexachlorocyclopentadiene	237				<MDL
14. 2-Chloronaphthalene	162				<MDL
15. Acenaphthylene	152				<MDL
17. Dimethylphthalate	163				<MDL
18. Acenaphthene	154				<MDL
19. 2,4-Dinitrotoluene	165				<MDL
20. Fluorene	166				<MDL
21. Diethylphthalate	149				<MDL
22. N-Nitrodiphenylamine	169				<MDL
23. 4-Bromophenylphentyl ether	248				<MDL

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188	2253	67,653	56.4	100.0
2.	Chrysene D-12	240	3211	44,472	45.6	100.0
3.						
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188		132,499	110.4	100.0
2.	Chrysene D-12	240		76,944	91.7	100.0
3.						
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
24.	Hexachlorobenzene	284				<MDL
25.	Phenanthrene	178				<MDL
26.	Anthracene	178				<MDL
27.	Di-n-Butylphthalate	149				<MDL
28.	Fluoranthene	202				<MDL
29.	Pyrene	202				<MDL
30.	Butylbenzylphthalate	149				<MDL
31.	Benz[a]anthracene	228				<MDL
32.	3,3'-Dichlorobenzidine	252				<MDL
33.	Chrysene	228				<MDL
34.	Bis[2-ethylhexyl]phthalate	149				2.9
35.	Di-n-Octylphthalate	149				<MDL
36.	Benzo[b]Fluoranthene	252				<MDL
37.	Benzo[k]Fluoranthene	252				<MDL
38.	Benzo[a]Pyrene	252				<MDL
39.	1,2-Diphenylhydrazine	77				<MDL
40.	Benzidine	184				<MDL
41.	4-Chlorophenyl phenyl ether	204				<MDL
42.	N-Nitroso-n-propylamine	70				<MDL

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
24.	Hexachlorobenzene	284				<MDL
25.	Phenanthrene	178		26966	15.8	20.0
26.	Anthracene	178				<MDL
27.	Di-n-Butylphthalate	149				<MDL
28.	Fluoranthene	202	2833	38619	22.7	20.0
29.	Pyrene	202				<MDL
30.	Butylbenzylphthalate	149				<MDL
31.	Benz[a]anthracene	228				<MDL
32.	3,3'-Dichlorobenzidine	252				<MDL
33.	Chrysene	228		34949	72.4	75.0
34.	Bis[2-ethylhexyl]phthalate	149				<MDL
35.	Di-n-Octylphthalate	149				<MDL
36.	Benzo[b]Fluoranthene	252	3752	22655	20.1	20.0
37.	Benzo[k]Fluoranthene	252				<MDL
38.	Benzo[a]Pyrene	252				<MDL
39.	1,2-Diphenylhydrazine	77				<MDL
40.	Benzidine	184				<MDL
41.	4-Chlorophenyl pnenyl ether	204				<MDL
42.	N-Nitroso-n-propylamine	70				<MDL

Environmental Trace Substances Research Center
Base Neutral Result Sheet

Sample Source: Burns & McDonnell
Submitter ID#:
ETSRC ID#: 51205RSPK Data File#: BNRSPK
Sample Matrix: Water
Method: U.S.E.P.A. #625
Date Received: January 14, 1986
Date Analyzed: January 15, 1986 Conc. Units: mcg/L
Analyst: Carl Orazio

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1.	Bis[2-Chloroethyl]ether	93				<MDL
2.	1,3-Dichlorobenzene	146				<MDL
3.	1,4-Dichlorobenzene	146				<MDL
4.	1,2-Dichlorobenzene	146				<MDL
5.	Bis[2-Chlorophropyl]ether	45				<MDL
6.	Hexachloroethane	117				<MDL
7.	Nitrobenzene	77				<MDL
8.	Isophorone	82				<MDL
9.	Bis[2-Chloroethoxy]methane	93				<MDL
10.	Trichlorobenzene	180				<MDL
11.	Naphthalene	128				<MDL
12.	Hexachlorobutadiene	225				<MDL
13.	Hexachlorocyclopentadiene	237				<MDL
14.	2-Chloronaphthalene	162				<MDL
15.	Acenaphthylene	152				<MDL
17.	Dimethylphthalate	163				<MDL
18.	Acenaphthene	154				<MDL
19.	2,4-Dinitrotoluene	165				<MDL
20.	Fluorene	166	2054	16555	19.3	20.0
21.	Diethylphthalate	149				<MDL
22.	N-Nitrodiphenylamine	169				<MDL
23.	4-Bromophenylphentyl ether	248				<MDL

Environmental Trace Substances Research Center

Base Neutral Result Sheet

Sample Source: Burns & McDonnell

Submitter ID#:

ETSRC ID#: 5120524S; Spike Sample   Data File#: BN5120524S

Sample Matrix: Water

Method: U.S.E.P.A. #625

Date Received: December 17, 1985

Date Analyzed: January 22, 1986   Conc. Units: mcg/L

Analyst: Carl Orazio

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc	Spk Conc
1. Bis[2-Chloroethyl]ether	93				<MDL	
2. 1,3-Dichlorobenzene	146				<MDL	
3. 1,4-Dichlorobenzene	146				<MDL	
4. 1,2-Dichlorobenzene	146				<MDL	
5. Bis[2-Chlorophropyl]ether	45				<MDL	
6. Hexachloroethane	117				<MDL	
7. Nitrobenzene	77				<MDL	
8. Isophorone	82				<MDL	
9. Bis[2-Chloroethoxy]methane	93				<MDL	
10. Trichlorobenzene	180				<MDL	
11. Naphthalene	128				<MDL	
12. Hexachlorobutadiene	225				<MDL	
13. Hexachlorocyclopentadiene	237				<MDL	
14. 2-Chloronaphthalene	162				<MDL	
15. Acenaphthylene	152				<MDL	
17. Dimethylphthalate	163				<MDL	
18. Acenaphthene	154				<MDL	
19. 2,4-Dinitrotoluene	165				<MDL	
20. Fluorene	166	2059	11222	17.9	19.2	20.0
21. Diethylphthalate	149				<MDL	
22. N-Nitrodiphenylamine	169				<MDL	

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188	2410	213,353	114.5	100.0
2.	Chrysene D-12	240	3370	160,419		100.0
3.						
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

Environmental Trace Substances Research Center

Base Neutral Result Sheet

Sample Source: Burns & McDonnell
Submitter ID#:
ETSRC ID#: 6010117 Data File#: BN6010117
Sample Matrix: Water
Method: U.S.E.P.A. #625
Date Received: January
Date Analyzed: January 23, 1986 Conc. Units: mcg/L
Analyst: Carl Orazio

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1.	Bis[2-Chloroethyl]ether	93				<MDL
2.	1,3-Dichlorobenzene	146				<MDL
3.	1,4-Dichlorobenzene	146	861	542	1.0	0.94
4.	1,2-Dichlorobenzene	146				<MDL
5.	Bis[2-Chlorophropyl]ether	45				<MDL
6.	Hexachloroethane	117				<MDL
7.	Nitrobenzene	77				<MDL
8.	Isophorone	82				<MDL
9.	Bis[2-Chloroethoxy]methane	93				<MDL
10.	Trichlorobenzene	180				<MDL
11.	Naphthalene	128	1262	1360	0.90	0.86
12.	Hexachlorobutadiene	225				<MDL
13.	Hexachlorocyclopentadiene	237				<MDL
14.	2-Chloronaphthalene	162				<MDL
15.	Acenaphthylene	152				<MDL
17.	Dimethylphthalate	163				<MDL
18.	Acenaphthene	154				<MDL
19.	2,4-Dinitrotoluene	165				<MDL
20.	Fluorene	166				<MDL
21.	Diethylphthalate	149	2080	3545	1.85	1.75
22.	N-Nitrodiphenylamine	169				<MDL
23.	4-Bromophenylphentyl ether	248				<MDL

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188	2416	132398	113.5	100.0
2.	Chrysene D-12	240	3373	107540	105.0	100.0
3.						
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

Environmental Trace Substances Research Center
Base Neutral Result Sheet

Sample Source: Burns & McDonnell
Submitter ID#: D-94 OR
ETSRC ID#: 5120528 Data File#: BN5120528
Sample Matrix: Water
Method: U.S.E.P.A. #625
Date Received. December 17, 1985
Date Analyzed: January 23, 1986 Conc. Units: mcg/L
Analyst: Carl Orazio

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1.	Bis[2-Chloroethyl]ether	93				<MDL
2.	1,3-Dichlorobenzene	146				<MDL
3.	1,4-Dichlorobenzene	146				<MDL
4.	1,2-Dichlorobenzene	146				<MDL
5.	Bis[2-Chlorophropyl]ether	45				<MDL
6.	Hexachloroethane	117				<MDL
7.	Nitrobenzene	77				<MDL
8.	Isophorone	82				<MDL
9.	Bis[2-Chloroethoxy]methane	93				<MDL
10.	Trichlorobenzene	180				<MDL
11.	Naphthalene	128				<MDL
12.	Hexachlorobutadiene	225				<MDL
13.	Hexachlorocyclopentadiene	237				<MDL
14.	2-Chloronaphthalene	162				<MDL
15.	Acenaphthylene	152				<MDL
17.	Dimethylphthalate	163				<MDL
18.	Acenaphthene	154				<MDL
19.	2,4-Dinitrotoluene	165				<MDL
20.	Fluorene	166				<MDL
21.	Diethylphthalate	149				<MDL
22.	N-Nitrodiphenylamine	169				<MDL
23.	4-Bromophenylphentyl ether	248				<MDL

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188	2415	103659	88.9	100.0
2.	Chrysene D-12	240	3371	124926	122.0	100.0
3.						
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.	1,1' Ethane Bis Oxy(Ethoxy) [2]Ethoxy	1032	No Match	59		
2.	Trimethyl Cyclohexe-1-One	1081	No Match	123		
3.	Tetraoxydodecane	1945	969	59		
4.						
5.						
6.						
7.						
8.						
9.						
10.						

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188	2415	115742	99.3	100.0
2.	Chrysene D-12	240	3372	104983	102.5	100.0
3.						
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.	Trimethyl Cyclohexane-1-One	1080	No Match	123		
2.	Hexane Dioc Acid Dioctyl Ester	3256	919			
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
24. Hexachlorobenzene	284				<MDL
25. Phenanthrene	178				<MDL
26. Anthracene	178				<MDL
27. Di-n-Butylphthalate	149				<MDL
28. Fluoranthene	202				<MDL
29. Pyrene	202				<MDL
30. Butylbenzylphthalate	149				<MDL
31. Benz[a]anthracene	228				<MDL
32. 3,3'-Dichlorobenzidine	252				<MDL
33. Chrysene	228				<MDL
34. Bis[2-ethylhexyl]phthalate	149	3450	4515	3.7	3.7
35. Di-n-Octylphthalate	149				<MDL
36. Benzo[b]Fluoranthene	252				<MDL
37. Benzo[k]Fluoranthene	252				<MDL
38. Benzo[a]Pyrene	252				<MDL
39. 1,2-Diphenylhydrazine	77				<MDL
40. Benzidine	184				<MDL
41. 4-Chlorophenyl phenyl ether	204				<MDL
42. N-Nitroso-n-propylamine	70				<MDL

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
24. Hexachlorobenzene	284				<MDL
25. Phenanthrene	178				<MDL
26. Anthracene	178				<MDL
27. Di-n-Butylphthalate	149				<MDL
28. Fluoranthene	202				<MDL
29. Pyrene	202				<MDL
30. Butylbenzylphthalate	149				<MDL
31. Benz[a]anthracene	228				<MDL
32. 3,3'-Dichlorobenzidine	252				<MDL
33. Chrysene	228				<MDL
34. Bis[2-ethylhexyl]phthalate	149				<MDL
35. Di-n-Octylphthalate	149				<MDL
36. Benzo[b]Fluoranthene	252				<MDL
37. Benzo[k]Fluoranthene	252				<MDL
38. Benzo[a]Pyrene	252				<MDL
39. 1,2-Diphenylhydrazine	77				<MDL
40. Benzidine	184				<MDL
41. 4-Chlorophenyl phenyl ether	204				<MDL
42. N-Nitroso-n-propylamine	70				

Environmental Trace Substances Research Center
Base Neutral Result Sheet

Sample Source: Burns & McDonnell
Submitter ID#: D-95 OR
ETSRC ID#: 5120529 Data File#: BN5120529
Sample Matrix: Water
Method: U.S.E.P.A. #625
Date Received: December 17, 1985
Date Analyzed: January 20, 1986 Conc. Units: mcg/L
Analyst: Carl Orazio

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1.	Bis[2-Chloroethyl]ether	93				<MDL
2.	1,3-Dichlorobenzene	146				<MDL
3.	1,4-Dichlorobenzene	146				<MDL
4.	1,2-Dichlorobenzene	146				<MDL
5.	Bis[2-Chlorophropyl]ether	45				<MDL
6.	Hexachloroethane	117				<MDL
7.	Nitrobenzene	77				<MDL
8.	Isophorone	82				<MDL
9.	Bis[2-Chloroethoxy]methane	93				<MDL
10.	Trichlorobenzene	180				<MDL
11.	Naphthalene	128				<MDL
12.	Hexachlorobutadiene	225				<MDL
13.	Hexachlorocyclopentadiene	237				<MDL
14.	2-Chloronaphthalene	162				<MDL
15.	Acenaphthylene	152				<MDL
17.	Dimethylphthalate	163				<MDL
18.	Acenaphthene	154				<MDL
19.	2,4-Dinitrotoluene	165				<MDL
20.	Fluorene	166				<MDL
21.	Diethylphthalate	149				<MDL
22.	N-Nitrodiphenylamine	169				<MDL
23.	4-Bromophenylphentyl ether	248				<MDL

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188	2426	159,063	85.3	100.0
2.	Chrysene D-12	240	3384	88,236	105.0	100.0
3.						
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.	Ethane 1,1'-Oxy Bis (2-Ethoxy)	1029	943	59		
2.	Diethyl Carbitol	1085				
3.		1632				
4.		2051				
5.						
6.						
7.						
8.						
9.						
10.						

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
24. Hexachlorobenzene	284				<MDL
25. Phenanthrene	178				<MDL
26. Anthracene	178				<MDL
27. Di-n-Butylphthalate	149				<MDL
28. Fluoranthene	202				<MDL
29. Pyrene	202				<MDL
30. Butylbenzylphthalate	149				<MDL
31. Benz[a]anthracene	228				<MDL
32. 3,3'-Dichlorobenzidine	252				<MDL
33. Chrysene	228				<MDL
34. Bis[2-ethylhexyl]phthalate	149				<MDL
35. Di-n-Octylphthalate	149				<MDL
36. Benzo[b]Fluoranthene	252				<MDL
37. Benzo[k]Fluoranthene	252				<MDL
38. Benzo[a]Pyrene	252				<MDL
39. 1,2-Diphenylhydrazine	77				<MDL
40. Benzidine	184				<MDL
41. 4-Chlorophenyl phenyl ether	204				<MDL
42. N-Nitroso-n-propylamine	70				

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
23.	4-Bromophenylphentyl ether	248				<MDL
24.	Hexachlorobenzene	284				<MDL
25.	Phenanthrene	178				<MDL
26.	Anthracene	178				<MDL
27.	Di-n-Butylphthalate	149				<MDL
28.	Fluoranthene	202				<MDL
29.	Pyrene	202				<MDL
30.	Butylbenzylphthalate	149				<MDL
31.	Benz[a]anthracene	228				<MDL
32.	3,3'-Dichlorobenzidine	252				<MDL
33.	Chrysene	228				<MDL
34.	Bis[2-ethylhexyl]phthalate	149				<MDL
35.	Di-n-Octylphthalate	149				<MDL
36.	Benzo[b]Fluoranthene	252				<MDL
37.	Benzo[k]Fluoranthene	252				<MDL
38.	Benzo[a]Pyrene	252				<MDL
39.	1,2-Diphenylhydrazine	77				<MDL
40.	Benzidine	184				<MDL
41.	4-Chlorophenyl phenyl ether	204				<MDL
42.	N-Nitroso-n-propylamine	70				<MDL

Environmental Trace Substances Research Center

Base Neutral Result Sheet

Sample Source: Burns & McDonnell
Submitter ID#: D-810R
ETSRC ID#: 5120516 Data File#: BN0516RP
Sample Matrix: Water
Method: U.S.E.P.A. #625
Date Received: December 17, 1985
Date Analyzed: February 10, 1986 Conc. Units: mcg/L
Analyst: Carl Orazio

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Bis[2-Chloroethyl]ether	93				<MDL
2. 1,3-Dichlorobenzene	146				<MDL
3. 1,4-Dichlorobenzene	146				<MDL
4. 1,2-Dichlorobenzene	146				<MDL
5. Bis[2-Chlorophropyl]ether	45				<MDL
6. Hexachloroethane	117				<MDL
7. Nitrobenzene	77				<MDL
8. Isophorone	82				<MDL
9. Bis[2-Chloroethoxy]methane	93				<MDL
10. Trichlorobenzene	180				<MDL
11. Naphthalene	128				<MDL
12. Hexachlorobutadiene	225				<MDL
13. Hexachlorocyclopentadiene	237				<MDL
14. 2-Chloronaphthalene	162				<MDL
15. Acenaphthylene	152				<MDL
17. Dimethylphthalate	163				<MDL
18. Acenaphthene	154				<MDL
19. 2,4-Dinitrotoluene	165				<MDL
20. Fluorene	166				<MDL
21. Diethylphthalate	149				<MDL
22. N-Nitrodiphenylamine	169				<MDL

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188	2423	134,889	112.4	100.0
2.	Chrysene D-12	240	3381	117,819	120.8	100.0
3.						
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
24.	Hexachlorobenzene	284				<MDL
25.	Phenanthrene	178				<MDL
26.	Anthracene	178				<MDL
27.	Di-n-Butylphthalate	149	3225	885	0.48	0.43
28.	Fluoranthene	202				<MDL
29.	Pyrene	202				<MDL
30.	Butylbenzylphthalate	149				<MDL
31.	Benz[a]anthracene	228				<MDL
32.	3,3'-Dichlorobenzidine	252				<MDL
33.	Chrysene	228				<MDL
34.	Bis[2-ethylhexyl]phthalate	149	3459	33,100	24.8	22.1
35.	Di-n-Octylphthalate	149	3681	5769	2.6	2.3
36.	Benzo[b]Fluoranthene	252				<MDL
37.	Benzo[k]Fluoranthene	252				<MDL
38.	Benzo[a]Pyrene	252				<MDL
39.	1,2-Diphenylhydrazine	77				<MDL
40.	Benzidine	184				<MDL
41.	4-Chlorophenyl phenyl ether	204				<MDL
42.	N-Nitroso-n-propylamine	70				<MDL

Environmental Trace Substances Research Center
Base Neutral Result Sheet

Sample Source: Burns & McDonnell
Submitter ID#: D-87 0R
ETSRC ID#: 5120521 Data File#: BN5120521
Sample Matrix: Water
Method: U.S.E.P.A. #625
Date Received: December 17, 1985
Date Analyzed: January 21, 1986 Conc. Units: mcg/L
Analyst: Carl Orazio

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1.	Bis[2-Chloroethyl]ether	93				<MDL
2.	1,3-Dichlorobenzene	146				<MDL
3.	1,4-Dicnlorobenzene	146				<MDL
4.	1,2-Dichlorobenzene	146				<MDL
5.	Bis[2-Chlorophropyl]ether	45				<MDL
6.	Hexachloroethane	117				<MDL
7.	Nitrobenzene	77				<MDL
8.	Isophorone	82				<MDL
9.	Bis[2-Chloroethoxy]methane	93				<MDL
10.	Trichlorobenzene	180				<MDL
11.	Naphthalene	128				<MDL
12.	Hexachlorobutadiene	225				<MDL
13.	Hexachlorocyclopentadiene	237				<MDL
14.	2-Chloronaphthalene	162				<MDL
15.	Acenaphthylene	152				<MDL
17.	Dimethylphthalate	163				<MDL
18.	Acenaphthene	154				<MDL
19.	2,4-Dinitrotoluene	165				<MDL
20.	Fluorene	166				<MDL
21.	Diethylphthalate	149				<MDL
22.	N-Nitrodiphenylamine	169				<MDL
23.	4-Bromophenylphentyl ether	248				<MDL

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188	2421	138,263	115.2	100.0
2.	Chrysene D-12	240	3378	77,436	79.4	100.0
3.						
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.	Methyl-3-Amino-1,24 Triazol	777	976	98		
2.	Propanol, 1-(2-Ethoxypropoxy)	848	868	59		
3.	3,5 Dimethyl-3-Hexanol	885	868	73		
4.						
5.						
6.						
7.						
8.						
9.						
10.						

Result Summary Sheet

Submitter ID: Burns and McDonnel # I-59 OR

ETSRC ID: 5120514 R. Data File: A5120514

Sample Matrix: Water

Analytes: Priority pollutant phenols

Method: EPA604 - GC/MS

Date Recieved/Analyzed: December 1986/Jan. 1, 1986

Analyst: Carl Orazio

Conc. Units: mcg/L

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1.	Phenol					<MDL
2.	2-Chlorophenol					<MDL
3.	2-Nitrophenol					<MDL
4.	2,4-Dimethylphenol					<MDL
5.	2,4-Dichlorophenol					<MDL
6.	4-Chloro, 3-Methylphenol					<MDL
7.	2,4,6-Trichlorophenol					<MDL
8.	2.4-Dinitrophenol	1695	878			10.0
9.	4-Nitrophenol					<MDL
10.	4,6-Dinitro, 2-Methylphenol					<MDL
11.	Pentachlorophenol	2119	4948			9.6
	Phenol D-5 (Surrogate) rec					38%

Result Summary Sheet

Submitter ID: Burns and McDonnel # S-80 OR

ETSRC ID: 5120515 R. Data File. A5120515

Sample Matrix: Water

Analytes: Priority pollutant phenols

Method: EPA604 - GC/MS

Date Recieved/Analyzed: Dec. 1986/Jan. 1, 1986

Analyst: Carl Orazio

Conc Units: mcg/L

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Phenol					<MDL
2. 2-Chlorophenol					<MDL
3. 2-Nitrophenol					<MDL
4. 2,4-Dimethylphenol					<MDL
5. 2,4-Dichlorophenol					<MDL
6. 4-Chloro, 3-Methylphenol					<MDL
7. 2,4,6-Trichlorophenol					<MDL
8. 2,4-Dinitrophenol					<MDL
9. 4-Nitrophenol					<MDL
10. 4,6-Dinitro, 2-Methylphenol					<MDL
11. Pentachlorophenol					<MDL
Phenol D-5 (Surrogate) rec					37.6%

Result Summary Sheet

Submitter ID: Burns and McDonnel #

ETSRC ID: 1 L Samples-Detection Levels Table R. Data File:

Sample Matrix: Water

Analytes. Priority pollutant phenols

Method: EPA604 - GC/MS

Date Recieved/Analyzed: Dec 1986/Jan. 1, 1986

Analyst: Carl Orazio

Conc Units: MCG/L

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Phenol		639	9714		1.7
2 2-Chlorophenol		656	9004		0.9
3. 2-Nitrophenol		960	2254		3.4
4 2,4-Dimethylphenol		989	5515		8.0
5. 2,4-Dichlorophenol		1030	4478		1.8
6. 4-Chloro, 3-Methylphenol		1283	20354		1.5
7. 2,4,6-Trichlorophenol		1406	12807		1.6
8. 2,4-Dinitrophenol		1687	2070		9.2
9. 4-Nitrophenol		1733	7940		6.8
10. 4,6-Dinitro, 2-Methylphenol		1871	8309		5.1
11. Pentachlorophenol		2108	16647		1.9

Phenol D-5 (Surrogate) rec

Result Summary Sheet

Submitter ID: Burns and McDonnel # 5-51 OR

ETSRC ID: 5120513d R. Data File: A5120513

Sample Matrix: Water

Analytes: Priority pollutant phenols

Method: EPA604 - GC/MS

Date Recieved/Analyzed: Dec. 1986/Jan. 1, 1986

Analyst: Carl Orazio

Conc. Units: mcg/L

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Phenol		644	3951	2.4	6.9
2. 2-Chlorophenol					<MDL
3. 2-Nitrophenol					<MDL
4. 2,4-Dimethylphenol					<MDL
5. 2,4-Dichlorophenol					<MDL
6. 4-Chloro, 3-Methylphenol					<MDL
7. 2,4,6-Trichlorophenol					<MDL
8. 2,4-Dinitrophenol					<MDL
9. 4-Nitrophenol					<MDL
10. 4,6-Dinitro, 2-Methylphenol					<MDL
11. Pentachlorophenol					<MDL
Phenol D-5 (Surrogate) rec					45%

RESULT SUMMARY SHEETS

PHENOLIC PRIORITY POLLUTANTS

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188	2416	121366	100.0	100.0
2.	Chrysene D-12	240	3374	117996	114.4	114.4
3.						
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

Result Summary Sheet

Submitter ID: Burns and McDonnel # S-88 OR

ETSRC ID: 5120522 R. Data File: 5120522

Sample Matrix: Water

Analytes: Priority pollutant phenols

Method: EPA604 - GC/MS

Date Recieved/Analyzed: Dec. 1986/Jan. 1, 1986

Analyst: Carl Orazio

Conc. Units: mcg/L

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Phenol					<MDL
2 2-Chlorophenol					<MDL
3. 2-Nitrophenol					<MDL
4. 2,4-Dimethylphenol					<MDL
5. 2,4-Dichlorophenol					<MDL
6. 4-Chloro, 3-Methylphenol					<MDL
7. 2,4,6-Trichlorophenol					<MDL
8. 2,4-Dinitrophenol					<MDL
9. 4-Nitrophenol					<MDL
10. 4,6-Dinitro, 2-Methylphenol					<MDL
11. Pentachlorophenol					<MDL
Phenol D-5 (Surrogate) rec					27%

Result Summary Sheet

Submitter ID: Burns and McDonnel # D-89 OR

ETSRC ID. 5120523 R. Data File: 5120523

Sample Matrix: Water

Analytes: Priority pollutant phenols

Method: EPA604 - GC/MS

Date Recieved/Analyzed: Dec. 1986/Jan. 1, 1986

Analyst: Carl Orazio

Conc. Units: mcg/L

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1.	Phenol					<MDL
2.	2-Chlorophenol					<MDL
3.	2-Nitrophenol					<MDL
4.	2,4-Dimethylphenol					<MDL
5.	2,4-Dichlorophenol					<MDL
6.	4-Chloro, 3-Methylphenol					<MDL
7.	2,4,6-Trichlorophenol					<MDL
8.	2,4-Dinitrophenol					<MDL
9.	4-Nitrophenol					<MDL
10.	4,6-Dinitro, 2-Methylphenol					<MDL
11.	Pentachlorophenol					<MDL
	Phenol D-5 (Surrogate) rec					21.6%

Result Summary Sheet

Submitter ID: Burns and McDonnel # D-9c OR

ETSRC ID: 5120524 R. Data File: 5120524

Sample Matrix: Water

Analytes: Priority pollutant phenols

Method. EPA604 - GC/MS

Date Recieved/Analyzed. Dec. 1986/Jan. 1, 1986

Analyst: Carl Orazio

Conc. Units: mcg/L

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Phenol					<MDL
2. 2-Chlorophenol					<MDL
3. 2-Nitrophenol					<MDL
4. 2,4-Dimethylphenol					<MDL
5. 2,4-Dichlorophenol					<MDL
6. 4-Chloro, 3-Methylphenol					<MDL
7. 2,4,6-Trichlorophenol					<MDL
8. 2,4-Dinitrophenol					<MDL
9. 4-Nitrophenol					<MDL
10. 4,6-Dinitro, 2-Methylphenol					<MDL
11. Pentachlorophenol					<MDL

Phenol D-5 (Surrogate) rec

Result Summary Sheet

Submitter ID: Burns and McDonnel # D-91 CR

ETSRC ID: 5120525   R. Data File: A5120525

Sample Matrix: Water

Analytes: Priority pollutant phenols

Method: EPA604 - GC/MS

Date Recieved/Analyzed. Dec. 1986/Jan. 1, 1986

Analyst: Carl Orazio

Conc. Units: mcg/L

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1.	Phenol					<MDL
2.	2-Chlorophenol					<MDL
3.	2-Nitrophenol					<MDL
4.	2,4-Dimethylphenol					<MDL
5.	2,4-Dichlorophenol					<MDL
6.	4-Chloro, 3-Methylphenol					<MDL
7.	2,4,6-Trichlorophenol					<MDL
8.	2,4-Dinitrophenol					<MDL
9.	4-Nitrophenol					<MDL
10.	4,6-Dinitro, 2-Methylphenol					<MDL
11.	Pentachlorophenol					<MDL
	Phenol D-5 (Surrogate) rec					21.3%

Result Summary Sheet

Submitter ID: Burns and McDonnel # D-92 OR

ETSRC ID: 5120526 R. Data File: 5120526

Sample Matrix: Water

Analytes. Priority pollutant phenols

Method: EPA604 - GC/MS

Date Recieved/Analyzed: Dec. 1986/Jan. 1, 1986

Analyst: Carl Orazio

Conc Units: mcg/L

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Phenol		652	3675		18.6
2. 2-Chlorophenol					<MDL
3. 2-Nitrophenol					<MDL
4. 2,4-Dimethylphenol					<MDL
5. 2,4-Dichlorophenol					<MDL
6. 4-Chloro, 3-Methylphenol					<MDL
7. 2,4,6-Trichlorophenol					<MDL
8. 2,4-Dinitrophenol					<MDL
9. 4-Nitrophenol					<MDL
10. 4,6-Dinitro, 2-Metnylphenol					<MDL
11. Pentachlorophenol					<MDL
Phenol D-5 (Surrogate) rec					20.5%

Result Summary Sheet

Submitter ID: Burns and McDonnel # D-93 OR

ETSRC ID. 5120527 R. Data File: A5120527

Sample Matrix: Water

Analytes: Priority pollutant phenols

Method: EPA604 - GC/MS

Date Recieved/Analyzed: Dec. 1986/Jan. 1, 1986

Analyst: Carl Orazio

Conc. Units: mcg/L

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1.	Phenol			1349		6.6
2.	2-Chlorophenol					<MDL
3.	2-Nitrophenol					<MDL
4.	2,4-Dimethylphenol					<MDL
5.	2,4-Dichlorophenol					<MDL
6.	4-Chloro, 3-Methylphenol					<MDL
7.	2,4,6-Trichlorophenol					<MDL
8.	2,4-Dinitrophenol					<MDL
9.	4-Nitrophenol					<MDL
10.	4,6-Dinitro, 2-Methylphenol					<MDL
11.	Pentachlorophenol					<MDL
	Phenol D-5 (Surrogate) rec					21.2%

Result Summary Sheet

Submitter ID: Burns and McDonnel # D-81 OR

ETSRC ID. 5120516 R. Data File A5120516

Sample Matrix: Water

Analytes. Priority pollutant phenols

Method. EPA604 - GC/MS

Date Recieved/Analyzed: Dec. 1986/Jan. 1 1986

Analyst: Carl Orazio

Conc. Units: mcg/L

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Phenol					<MDL
2. 2-Chlorophenol					<MDL
3. 2-Nitrophenol					<MDL
4. 2,4-Dimethylphenol					<MDL
5. 2,4-Dichlorophenol					<MDL
6 4-Chloro 3-Methylphenol					<MDL
7. 2,4,6-Trichlorophenol					<MDL
8. 2,4-Dinitrophenol					<MDL
9. 4-Nitrophenol					<MDL
10. 4,6-Dinitro, 2-Methylphenol					<MDL
11. Pentachlorophenol					<MDL
Phenol D-5 (Surrogate) rec					27.9%

Result Summary Sheet

Submitter ID: Burns and McDonnel # S-82 OR

ETSRC ID: 5120517 R. Data File: A5120517

Sample Matrix: Water

Analytes: Priority pollutant phenols

Method: EPA604 - GC/MS

Date Recieved/Analyzed: Dec. 1986/Jan. 1, 1986

Analyst: Carl Orazio

Conc Units: mcg/L

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Phenol		647	4067		7.1
2. 2-Chlorophenol					<MDL
3. 2-Nitrophenol					<MDL
4 2,4-Dimethylphenol					<MDL
5. 2,4-Dichlorophenol					<MDL
6. 4-Chloro, 3-Methylphenol					<MDL
7. 2,4,6-Trichlorophenol					<MDL
8. 2,4-Dinitrophenol					<MDL
9. 4-Nitrophenol					<MDL
10. 4,6-Dinitro, 2-Methylphenol					<MDL
11. Pentachlorophenol					<MDL
Phenol D-5 (Surrogate) rec					24.0%

Result Summary Sheet

Submitter ID: Burns and McDonnel # D-93 CR

ETSRC ID: 5120518 R. Data File: A5120518

Sample Matrix: Water

Analytes: Priority pollutant phenols

Method. EPA604 - GC/MS

Date Recieved/Analyzed. Dec. 1986/Jan. 1, 1986

Analyst: Carl Orazio

Conc. Units: mcg/L

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Phenol		653	4214		7.30
2. 2-Chlorophenol					<MDL
3. 2-Nitrophenol					<MDL
4 2,4-Dimethylphenol					<MDL
5. 2,4-Dichlorophenol					<MDL
6. 4-Chloro, 3-Methylphenol					<MDL
7. 2,4,6-Trichlorophenol					<MDL
8. 2,4-Dinitrophenol					<MDL
9. 4-Nitrophenol					<MDL
10. 4,6-Dinitro 2-Methylphenol					<MDL
11. Pentachlorophenol					<MDL
Phenol D-5 (Surrogate) rec					36.4%

Result Summary Sheet

Submitter ID: Burns and McDonnel # S-84 OR
ETSRC ID. 5120519 R. Data File: 5120519
Sample Matrix: Water
Analytes: Priority pollutant phenols
Method: EPA604 - GC/MS
Date Recieved/Analyzed: Dec. 1986/Jan. 1, 1986
Analyst: Carl Orazio
Conc. Units: mcg/L

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1.	Phenol					<MDL
2	2-Chlorophenol					<MDL
3.	2-Nitrophenol					<MDL
4.	2,4-Dimethylphenol					<MDL
5.	2,4-Dichlorophenol					<MDL
6.	4-Chloro, 3-Methylphenol					<MDL
7.	2,4,6-Trichlorophenol					<MDL
8.	2,4-Dinitrophenol					<MDL
9.	4-Nitrophenol					<MDL
10.	4,6-Dinitro, 2-Methylphenol					<MDL
11.	Pentachlorophenol					<MDL
	Phenol D-5 (Surrogate) rec					35.5%

Result Summary Sheet

Submitter ID: Burns and McDonnel # D-85 OR

ETSRC ID: 5120520 R. Data File: 5120520

Sample Matrix: Water

Analytes: Priority pollutant phenols

Method: EPA604 - GC/MS

Date Recieved/Analyzed: Dec. 1986/Jan. 1, 1986

Analyst: Carl Orazio

Conc. Units: mcg/L

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1.	Phenol					<MDL
2.	2-Chlorophenol					<MDL
3.	2-Nitrophenol					<MDL
4.	2,4-Dimethylphenol					<MDL
5.	2,4-Dichlorophenol					<MDL
6.	4-Chloro, 3-Methylphenol					<MDL
7.	2,4,6-Trichlorophenol					<MDL
8.	2,4-Dinitrophenol					<MDL
9.	4-Nitrophenol					<MDL
10.	4,6-Dinitro, 2-Methylphenol					<MDL
11.	Pentachlorophenol					<MDL
	Phenol D-5 (Surrogate) rec					21.3%

Submitter ID: Burns and McDonnel # D-87 GR

ETSRC ID: 5120521 R. Data File: 5120521

Sample Matrix: Water

Analytes: Priority pollutant phenols

Method: EPA604 - GC/MS

Date Recieved/Analyzed: Dec. 1986/Jan. 1, 1986

Analyst: Carl Orazio

Conc. Units: mcg/L

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1.	Phenol					<MDL
2.	2-Chlorophenol					<MDL
3.	2-Nitrophenol					<MDL
4.	2,4-Dimethylphenol					<MDL
5.	2,4-Dichlorophenol					<MDL
6.	4-Chloro, 3-Methylphenol					<MDL
7.	2,4,6-Trichlorophenol					<MDL
8.	2,4-Dinitrophenol					<MDL
9.	4-Nitrophenol					<MDL
10.	4,6-Dinitro, 2-Methylphenol					<MDL
11.	Pentachlorophenol					<MDL
	Phenol D-5 (Surrogate) rec					20.6%

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc	Spk Conc
23. 4-Bromophenylphentyl ether	248				<MDL	
24. Hexachlorobenzene	284				<MDL	
25. Phenanthrene	178	2403	18634	15.3	16.4	20.0
26. Anthracene	178				<MDL	
27. Di-n-Butylphthalate	149				<MDL	
28. Fluoranthene	202	2838	23796	21.7	23.3	20.0
29. Pyrene	202				<MDL	
30. Butylbenzylphthalate	149				<MDL	
31. Benz[a]anthracene	228				<MDL	
32. 3,3'-Dichlorobenzidine	252				<MDL	
33. Chrysene	228	3379	23610	68.0	73.1	75.0
34. Bis[2-ethylhexyl]phthalate	149	3452	2961	2.7	2.90	
35. Di-n-Octylphthalate	149				<MDL	
36. Benzo[b]Fluoranthene	252	3753	17421	21.4	23.0	20.0
37. Benzo[k]Fluoranthene	252				<MDL	
38. Benzo[a]Pyrene	252				<MDL	
39. 1,2-Diphenylhydrazine	77				<MDL	
40. Benzidine	184				<MDL	
41. 4-Chlorophenyl phenyl ether	204				<MDL	
42. N-Nitroso-n-propylamine	70				<MDL	

SURROGATE RESULTS

	Compound	Quantity m/e	Scan #	Area	Det Conc	Spiked Conc
1.	Anthracene D-10	188	2410	110,948	91.4	100.0
2.	Chrysene D-12	240	3372	98,791	96.0	100.0
3.						
4.						

Tentatively Identified Compounds

	Compound	Scan #	NBS LIB FIT	Base m/e	Area	Est Conc
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

Environmental Trace Substances Research Center
Base Neutral Result Sheet

Sample Source: ETSRC AQ/QC
Submitter ID#:
ETSRC ID#: 51095 1Reagent Blank   Data File#: BN51205RB
Sample Matrix: Water
Method: U.S.E.P.A. #625
Date Received:
Date Analyzed: January 22, 1986   Conc. Units: mcg/L
Analyst: Carl Orazio

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Bis[2-Chloroethyl]ether	93				<MDL
2. 1,3-Dichlorobenzene	146				<MDL
3. 1,4-Dichlorobenzene	146				<MDL
4. 1,2-Dichlorobenzene	146				<MDL
5. Bis[2-Chlorophropyl]ether	45				<MDL
6. Hexachloroethane	117				<MDL
7. Nitrobenzene	77				<MDL
8. Isophorone	82				<MDL
9. Bis[2-Chloroethoxy]methane	93				<MDL
10. Trichlorobenzene	180				<MDL
11. Naphthalene	128				<MDL
12. Hexachlorobutadiene	225				<MDL
13. Hexachlorocyclopentadiene	237				<MDL
14. 2-Chloronaphthalene	162				<MDL
15. Acenaphthylene	152				<MDL
17. Dimethylphthalate	163				<MDL
18. Acenaphthene	154				<MDL
19. 2,4-Dinitrotoluene	165				<MDL
20. Fluorene	166				<MDL
21. Diethylphthalate	149				<MDL
22. N-Nitrodiphenylamine	169				<MDL
23. 4-Bromophenylphentyl ether	248				<MDL

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
24.	Hexachlorobenzene	284				<MDL
25.	Phenanthrene	178				<MDL
26.	Anthracene	178				<MDL
27.	Di-n-Butylphthalate	149				<MDL
28.	Fluoranthene	202				<MDL
29.	Pyrene	202				<MDL
30.	Butylbenzylphthalate	149				<MDL
31.	Benz[a]anthracene	228				<MDL
32.	3,3'-Dichlorobenzidine	252				<MDL
33.	Chrysene	228				<MDL
34.	Bis[2-ethylhexyl]phthalate	149	3453	9480	3.5	3.5
35.	Di-n-Octylphthalate	149				<MDL
36.	Benzo[b]Fluoranthene	252				<MDL
37.	Benzo[k]Fluoranthene	252				<MDL
38.	Benzo[a]Pyrene	252				<MDL
39.	1,2-Diphenylhydrazine	77				<MDL
40.	Benzidine	184				<MDL
41.	4-Chlorophenyl phenyl ether	204				<MDL
42.	N-Nitroso-n-propylamine	70				<MDL

RESULT SUMMARY SHEETS

VOLATILE PRIORITY POLLUTANTS

SUMMARY OF POLYCHLORINATED BIPHENYLS AND CHLORINATED PESTICIDE RESIDUE CONCENTRATIONS

(ng/L)

	HCB	Hepta-chlor	Aldrin	pp'DDE	Aroclor 1242	Aroclor 1254	Aroclor 1260					
85120513 S-510R	<2.0	<2.0	<2.0	10.6	<50.0	<50.0	<50.0					
85120514 I-590R	<2.0	<2.0	<2.0	11.6	<50.0	<50.0	<50.0					
85120515 S-800R	<2.0	<2.0	<2.0	25.0	<50.0	<50.0	<50.0					
85120516 D-810R	<2.0	<2.0	<2.0	12.5	<50.0	<50.0	<50.0					
85120517 S-820R	29.3	<2.0	<2.0	37.3	<50.0	<50.0	<50.0					
85120518 D830R	<2.0	<2.0	<2.0	<5.0	<50.0	<50.0	<50.0					
851205519 S840R	<2.0	<2.0	<2.0	5.1	<50.0	<50.0	<50.0					
85120520 D-850R	<2.0	<2.0	<2.0	<5.0	<50.0	<50.0	<50.0					
85120521 D-870R	<2.0	<2.0	<2.0	14.0	<50.0	<50.0	<50.0					
85120522 S-880R	8.5	<2.0	<2.0	6.2	<50.0	<50.0	<50.0					

SUMMARY OF POLYCHLORINATED BIPHENYLS AND CHLORINATED PESTICIDE RESIDUE CONCENTRATIONS

(ng/L)

	HCB	Hepta-chlor	Aldrin	pp'DDE	Aroclor 1242	Aroclor 1254	Aroclor 1260						
851205523 D-890R	8.2	<2.0	<2.0	117.0	<50.0	<50.0	<50.0						
85120524 D-900R	31.4	<2.0	<2.0	<5.0	<50.0	<50.0	<50.0						
85120525 D-910R	48.8	<2.0	<2.0	36.4	<50.0	<50.0	<50.0						
85120526 D-920R	9.3	<2.0	<2.0	23.3	<50.0	<50.0	<50.0						
85120527 D-930R	3.8	<2.0	<2.0	<5.0	<50.0	<50.0	<50.0						
85120528 D-940R	16.7	<2.0	<2.0	<5.0	<50.0	<50.0	<50.0						
85120529 D-950R	5.4	<2.0	<2.0	<5.0	<50.0	<50.0	<50.0						

SUMMARY OF CHLORINATED PESTICIDE RESIDUE CONCENTRATIONS ng/L (parts per trillion)

	αBHC	γBHC	βBHC	δBHC	Hept. Epox.	Chlor- danes	Dieldrin	Endrin	pp'DDD	pp'DDT	Methoxy- chlor	
85120513 S-510R	5.0	<5.0	<10.0	<10.0	<5.0	<15.0	<5.0	<5.0	<10.0	<10.0	<20.0	
85120514 I-590R	<5.0	<5.0	<10.0	<10.0	<5.0	<15.0	<5.0	<5.0	<10.0	<10.0	<20.0	
85120515 S-800R	<5.0	<5.0	<10.0	<10.0	<5.0	<15.0	<5.0	<5.0	<10.0	<10.0	<20.0	
85120516 D-810R	<5.0	<5.0	<10.0	<10.0	<5.0	<15.0	<5.0	<5.0	<10.0	<10.0	<20.0	
85120517 S-820R	<5.0	100.0	<10.0	<10.0	<5.0	258.0	14.6	<5.0	658.0	<10.0	<20.0	
85120518 D-830R	<5.0	<5.0	<10.0	504.0	<5.0	72.4	18.8	<5.0	197.0	50.6	<20.0	
85120519 S-840R	<5.0	<5.0	<10.0	312.0	<5.0	89.0	<5.0	140.0	<10.0	<10.0	<20.0	
85120520 D-850R	<5.0	<5.0	<10.0	70.0	<5.0	28.5	<5.0	<5.0	<10.0	<10.0	<20.0	
85120521 D-870R	<5.0	<5.0	<10.0	<10.0	<5.0	23.0	<5.0	<5.0	<10.0	<10.0	<20.0	
85120522 S-880R	<5.0	<5.0	<10.0	<10.0	<5.0	23.0	<5.0	<5.0	<10.0	<10.0	<20.0	

SUMMARY OF CHLORINATED PESTICIDE RESIDUE CONCENTRATIONS ng/L (parts per trillion)

	αBHC	γBHC	βBHC	δBHC	Hept. Epox.	Chlor-danes	Dieldrin	Endrin	pp'DDD	pp'DDT	Methoxy-chlor	
85120523 D-890R	<5.0	<5.0	<10.0	<10.0	<5.0	<15.0	<5.0	<5.0	<10.0	<10.0	<20.0	
85120524 D-900R	<5.0	<5.0	<10.0	<10.0	<5.0	<15.0	<5.0	<5.0	<10.0	<10.0	<20.0	
85120525 D-910R	<5.0	<5.0	<10.0	<10.0	<5.0	<15.0	<5.0	<5.0	<10.0	<10.0	<20.0	
85120526 D-920R	<5.0	<5.0	<10.0	<10.0	<5.0	<15.0	<5.0	<5.0	<10.0	<10.0	<20.0	
85120527 D-930R	<5.0	<5.0	<10.0	<10.0	<5.0	<15.0	<5.0	<5.0	<10.0	<10.0	<20.0	
85120528 D-940R	<5.0	<5.0	<10.0	<10.0	<5.0	<15.0	<5.0	<5.0	<10.0	<10.0	<20.0	
85120529 D-950R	<5.0	<5.0	<10.0	<10.0	<5.0	<15.0	<5.0	<5.0	<10.0	<10.0	<20.0	

Surrogate Results

	Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1.	Benzene D-8	84	528	71067	31.4	30.0
2.	Toluene D-8	100	715	31698	32.2	30.0
3.	p-Bromofluorobenzene	95	903	21185	33.5	30.0

Tentatively Identified Compounds

	Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1.	Acetone	58	226		-NQ-	

Environmental Trace Substances Research Center

Volatile Result Summary

Sample Source Burns & McDonnell

Submitter ID#: D-87

ETSRC ID#: 85120505 Data File#: VOL505

Sample Matrix: Water

Method: U.S.E.P.A. #624

Date Received: December 17, 1985

Date Analyzed: Conc. Units: mcg/L

Analyst: C. Orazio

Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1. Methylene chloride	84	209	6367	6.0	6.0
2. 1,1 Dichloroethylene	96				<MDL
3. 1,1 Dichloroethane	63				<MDL
4. 1,2 Dichloroethylene	96				<MDL
5. Chloroform	83				<MDL
6. 1,2, Dichloroethane	62				<MDL
7. 1,1,1 Trichloroethane	97				<MDL
8. Carbon tetrachloride	117				<MDL
9. Bromodichloromethane	127				<MDL
10. 1,2 Dichloropropane	65				<MDL
11. 1,3 Dichloropropylene	75				<MDL
12. Trichloroethylene	130				<MDL
13. Benzene	78				<MDL
14. cis 1,3 Dichloropropylene	75				<MDL
15. 1,1,2 Trichloroethane	97				<MDL
16. Dibromochloromethane	127				<MDL
17. 2 Chloroethylvinyl ether	63				<MDL
18. Bromoform	173				<MDL
19. Tetrachloroethylene	164				<MDL
20. 1,1,2,2 Tetrachloroethane	83				<MDL
21. Toluene	92				<MDL
22. Chlorobenzene	112				<MDL
23. Ethylbenzene	91				<MDL

Surrogate Results

Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1. Benzene D-8	84	528	65302	28.8	<MDL
2. Toluene D-8	100	715	27951	28.4	<MDL
3. p-Bromofluorobenzene	95	905	17151	27.4	<MDL

Tentatively Identified Compounds

Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1. Acetone	58	228	184247	-NQ-	

Environmental Trace Substances Research Center
Volatile Result Summary

Sample Source: Burns & McDonnell
Submitter ID#: D-85
ETSRC ID#: 85120504 Data File#: VOL504
Sample Matrix: Water
Method: U.S.E.P.A. #624
Date Received: December 17, 1985
Date Analyzed: Conc. Units: mcg/L
Analyst. C. Orazio

Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1. Methylene chloride	84	209	6947	6.6	6.3
2. 1,1 Dichloroethylene	96				<MDL
3. 1,1 Dichloroethane	63				<MDL
4. 1,2 Dichloroethylene	96				<MDL
5. Chloroform	83				<MDL
6. 1,2, Dichloroethane	62				<MDL
7. 1,1,1 Trichloroethane	97				<MDL
8 Carbon tetrachloride	117				<MDL
9. Bromodichloromethane	127				<MDL
10. 1,2 Dichloropropane	65				<MDL
11. 1,3 Dichloropropylene	75				<MDL
12. Trichloroethylene	130				<MDL
13. Benzene	78				<MDL
14. cis 1,3 Dichloropropylene	75				<MDL
15. 1,1,2 Trichloroethane	97				<MDL
16. Dibromochloromethane	127				<MDL
17. 2 Chloroethylvinyl ether	63				<MDL
18. Bromoform	173				<MDL
19. Tetrachloroethylene	164				<MDL
20. 1,1,2,2 Tetrachloroethane	83				<MDL
21. Toluene	92				<MDL
22. Chlorobenzene	112				<MDL
23. Ethylbenzene	91				

Surrogate Results

Compound	Qantity m/e	Scan #	Area	Conc.	Corr Conc
1. Benzene D-8	84	528	78043	34.4	30.0
2. Toluene D-8	100	716	34953	35.5	30.0
3. p-Bromofluorobenzene	95	904	2311	36.9	30.0

Tentatively Identified Compounds

Compound	Qantity m/e	Scan #	Area	Conc.	Corr Conc
1. Acetone	58	226	17749	-NA-	

Environmental Trace Substances Research Center

Volatile Result Summary

Sample Source: Burns & McDonnell

Submitter ID#: S-84

ETSRC ID#: 85120503 Data File#: VOL503

Sample Matrix: Water

Method: U.S.E.P.A. #624

Date Received: December 17, 1985

Date Analyzed: Conc. Units: mcg/L

Analyst: C. Orazio

	Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1.	Methylene chloride	84	211	6248	5.9	6.1
2.	1,1 Dichloroethylene	96				<MDL
3.	1,1 Dichloroethane	63				<MDL
4.	1,2 Dichloroethylene	96				<MDL
5.	Chloroform	83				<MDL
6.	1,2, Dichloroethane	62				<MDL
7.	1,1,1 Trichloroethane	97				<MDL
8.	Carbon tetrachloride	117				<MDL
9.	Bromodichloromethane	127				<MDL
10.	1,2 Dichloropropane	65				<MDL
11.	1,3 Dichloropropylene	75				<MDL
12.	Trichloroethylene	130				<MDL
13.	Benzene	78				<MDL
14.	cis 1,3 Dichloropropylene	75				<MDL
15.	1,1,2 Trichloroethane	97				<MDL
16.	Dibromochloromethane	127				<MDL
17.	2 Chloroethylvinyl ether	63				<MDL
18.	Bromoform	173				<MDL
19.	Tetrachloroethylene	164				<MDL
20.	1,1,2,2 Tetrachloroethane	83				<MDL
21.	Toluene	92				<MDL
22.	Chlorobenzene	112				<MDL
23.	Ethylbenzene	91				<MDL

Surrogate Results

	Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1.	Benzene D-8	84	528	77305	34.1	
2.	Toluene D-8	100	716	33920	34.4	
3.	p-Bromofluorobenzene	95	904	27581	43.8	

Tentatively Identified Compounds

	Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1.	Acetone	58	226	131557	-NQ-	

Environmental Trace Substances Research Center

Volatile Result Summary

Sample Source Burns & McDonnell

Submitter ID#: D-83

ETSRC ID#: 85120502 Data File#: VOL 502

Sample Matrix: Water

Method: U.S.E.P.A. #624

Date Received: December 17, 1985

Date Analyzed: Conc. Units: mcg/L

Analyst: C. Orazio

Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1. Methylene chloride	84	210	66538	63.0	55.2
2. 1,1 Dichloroethylene	96				<MDL
3. 1,1 Dichloroethane	63				<MDL
4. 1,2 Dichloroethylene	96				<MDL
5. Chloroform	83				<MDL
6. 1,2, Dichloroethane	62				<MDL
7. 1,1,1 Trichloroethane	97				<MDL
8. Carbon tetrachloride	117				<MDL
9. Bromodichloromethane	127				<MDL
10. 1,2 Dichloropropane	65				<MDL
11. 1,3 Dichloropropylene	75				<MDL
12. Trichloroethylene	130				<MDL
13. Benzene	78				<MDL
14. cis 1,3 Dichloropropylene	75				<MDL
15. 1,1,2 Trichloroethane	97				<MDL
16. Dibromochloromethane	127				<MDL
17. 2 Chloroethylvinyl ether	63				<MDL
18. Bromoform	173				<MDL
19. Tetrachloroethylene	164				<MDL
20. 1,1,2,2 Tetrachloroethane	83				<MDL
21. Toluene	92				<MDL
22. Chlorobenzene	112				<MDL
23. Ethylbenzene	91				<MDL

Surrogate Results

	Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1.	Benzene D-8	84	527	57577	25.4	30.0
2.	Toluene D-8	100	714	24133	24.5	30.0
3.	p-Bromofluorobenzene	95	903	17133	27.4	30.0

Tentatively Identified Compounds

	Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1.	Acetone	58	226		-NQ-	

Environmental Trace Substances Research Center
Volatile Result Summary

Sample Source: Burns & McDonnell
Submitter ID#: D-90
ETSRC ID#: 85120507 Data File#: VOL507
Sample Matrix: Water
Method: U.S.E.P.A. #624
Date Received: December 17, 1985
Date Analyzed: Conc. Units: mcg/L
Analyst: C. Orazio

Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1. Methylene chloride	84	209	96851	75.7	83.2
2. 1,1 Dichloroethylene	96				<MDL
3. 1,1 Dichloroethane	63				<MDL
4. 1,2 Dichloroethylene	96				<MDL
5. Chloroform	83				<MDL
6. 1,2, Dichloroethane	62				<MDL
7. 1,1,1 Trichloroethane	97				<MDL
8. Carbon tetrachloride	117				<MDL
9. Bromodichloromethane	127				<MDL
10. 1,2 Dichloropropane	65				<MDL
11. 1,3 Dichloropropylene	75				<MDL
12. Trichloroethylene	130				<MDL
13. Benzene	78				<MDL
14. cis 1,3 Dichloropropylene	75				<MDL
15. 1,1,2 Trichloroethane	97				<MDL
16. Dibromochloromethane	127				<MDL
17. 2 Chloroethylvinyl ether	63				<MDL
18. Bromoform	173				<MDL
19. Tetrachloroethylene	164				<MDL
20. 1,1,2,2 Tetrachloroethane	83				<MDL
21. Toluene	92				<MDL
22. Chlorobenzene	112				<MDL
23. Ethylbenzene	91				<MDL

Surrogate Results

	Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1.	Benzene D-8	84	527	107515	42.5	30.0
2.	Toluene D-8	100	715	50046	42.6	30.0
3.	p-Bromofluorobenzene	95	904	25339	31.1	30.0

Tentatively Identified Compounds

	Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1.	Acetone	58	230	3842	-NQ-	
2.	2-Methylheptadienediol	71	333		-NQ-	
3.	Hexane		488		-NQ-	

Environmental Trace Substances Research Center
Volatile Result Summary

Sample Source: Burns & McDonnell
Submitter ID#: D-92
ETSRC ID#: 85120509 Data File#: VOL509
Sample Matrix: Water
Method: U.S.E.P.A. #624
Date Received: December 17, 1985
Date Analyzed: Conc. Units: mcg/L
Analyst: C. Orazio

Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1. Methylene chloride	84	211	45017	35.2	51.0
2. 1,1 Dichloroethylene	96				
3. 1,1 Dichloroethane	63				
4. 1,2 Dichloroethylene	96				
5. Chloroform	83				
6. 1,2, Dichloroethane	62				
7. 1,1,1 Trichloroethane	97				
8. Carbon tetrachloride	117				
9. Bromodichloromethane	127				
10. 1,2 Dichloropropane	65				
11. 1,3 Dichloropropylene	75				
12. Trichloroethylene	130				
13. Benzene	78				
14. cis 1,3 Dichloropropylene	75				
15. 1,1,2 Trichloroethane	97				
16. Dibromochloromethane	127				
17. 2 Chloroethylvinyl ether	63				
18. Bromoform	173				
19. Tetrachloroethylene	164				
20. 1,1,2,2 Tetrachloroethane	83				
21. Toluene	92				
22. Chlorobenzene	112				
23. Ethylbenzene	91				

Surrogate Results

Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1. Benzene D-8	84	527	59317	26.2	
2. Toluene D-8	100	715	25144	25.5	
3. p-Bromofluorobenzene	95	904	15144	24.2	

Tentatively Identified Compounds

Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1. Acetone	71	332		-NQ-	

Environmental Trace Substances Research Center

Volatile Result Summary

Sample Source: Burns & McDonnell

Submitter ID#: D-91

ETSRC ID#: 85120508D

Data File#: VOL508D

Sample Matrix: Water

Method: U.S.E.P.A. #624

Date Received: December 17, 1985

Date Analyzed:

Conc. Units: mcg/L

Analyst: C. Orazio

Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1. Methylene chloride	84	210	3842	3.0	2.1
2. 1,1 Dichloroethylene	96				<MDL
3. 1,1 Dichloroethane	63				<MDL
4. 1,2 Dichloroethylene	96				<MDL
5. Chloroform	83				<MDL
6. 1,2, Dichloroethane	62				<MDL
7. 1,1,1 Trichloroethane	97				<MDL
8. Carbon tetrachloride	117				<MDL
9. Bromodichloromethane	127				<MDL
10. 1,2 Dichloropropane	65				<MDL
11. 1,3 Dichloropropylene	75				<MDL
12. Trichloroethylene	130				<MDL
13. Benzene	78				<MDL
14. cis 1,3 Dichloropropylene	75				<MDL
15. 1,1,2 Trichloroethane	97				<MDL
16. Dibromochloromethane	127				<MDL
17. 2 Chloroethylvinyl ether	63				<MDL
18. Bromoform	173				<MDL
19. Tetrachloroethylene	164				<MDL
20. 1,1,2,2 Tetrachloroethane	83				<MDL
21. Toluene	92				<MDL
22. Chlorobenzene	112				<MDL
23. Ethylbenzene	91				<MDL

Surrogate Results

	Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1.	Benzene D-8	84	527	69199	27.3	30.0
2.	Toluene D-8	100		27544	23.4	30.0
3.	p-Bromofluorobenzene	95		18556	22.7	30.0

Tentatively Identified Compounds

	Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1.	Acetone	58				

Environmental Trace Substances Research Center
Volatile Result Summary

Sample Source: Burns & McDonnell
Submitter ID#: D-91
ETSRC ID#: 85120508 Data File#: VOL508
Sample Matrix: Water
Method: U.S.E.P.A. #624
Date Received: December 17, 1985
Date Analyzed: Conc. Units: mcg/L
Analyst: C. Orazio

Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1. Methylene chloride	84	209	1764	1.4	1.6
2. 1,1 Dichloroethylene	96				<MDL
3. 1,1 Dichloroethane	63				<MDL
4. 1,2 Dichloroethylene	96				<MDL
5. Chloroform	83				<MDL
6. 1,2, Dichloroethane	62				<MDL
7. 1,1,1 Trichloroethane	97				<MDL
8. Carbon tetrachloride	117				<MDL
9. Bromodichloromethane	127				<MDL
10. 1,2 Dichloropropane	65				<MDL
11. 1,3 Dichloropropylene	75				<MDL
12. Trichloroethylene	130				<MDL
13. Benzene	78				<MDL
14. cis 1,3 Dichloropropylene	75				<MDL
15. 1,1,2 Trichloroethane	97				<MDL
16. Dibromochloromethane	127				<MDL
17. 2 Chloroethylvinyl ether	63				<MDL
18. Bromoform	173				<MDL
19. Tetrachloroethylene	164				<MDL
20. 1,1,2,2 Tetrachloroethane	83				<MDL
21. Toluene	92				<MDL
22. Chlorobenzene	112				<MDL
23. Ethylbenzene	91				<MDL

Surrogate Results

	Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1.	Benzene D-8	84	528	56116	22.8	30.0
2.	Toluene D-8	100	714	22687	19.3	30.0
3.	p-Bromofluorobenzene	95	904	15317	18.8	30.0

Tentatively Identified Compounds

	Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1.	Acetone	58				

Environmental Trace Substances Research Center

Volatile Result Summary

Sample Source: Burns & McDonnell

Submitter ID#: D-95

ETSRC ID#: 5120512

Data File#: VOL512

Sample Matrix: Water

Method: U.S.E.P.A. #624

Date Received: December 17, 1985

Date Analyzed:

Conc. Units: mcg/L

Analyst: C. Orazio

Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1. Methylene chloride	84	211	14849	11.6	10.3
2. 1,1 Dichloroethylene	96				<MDL
3. 1,1 Dichloroethane	63				<MDL
4. 1,2 Dichloroethylene	96				<MDL
5. Chloroform	83				<MDL
6. 1,2, Dichloroethane	62				<MDL
7. 1,1,1 Trichloroethane	97				<MDL
8. Carbon tetrachloride	117				<MDL
9. Bromodichloromethane	127				<MDL
10. 1,2 Dichloropropane	65				<MDL
11. 1,3 Dichloropropylene	75				<MDL
12. Trichloroethylene	130				<MDL
13. Benzene	78				<MDL
14. cis 1,3 Dichloropropylene	75				<MDL
15. 1,1,2 Trichloroethane	97				<MDL
16. Dibromochloromethane	127				<MDL
17. 2 Chloroethylvinyl ether	63				<MDL
18. Bromoform	173				<MDL
19. Tetrachloroethylene	164				<MDL
20. 1,1,2,2 Tetrachloroethane	83				<MDL
21. Toluene	92				<MDL
22. Chlorobenzene	112				<MDL
23. Ethylbenzene	91				<MDL

Surrogate Results

	Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1.	Benzene D-8	84	528	47338	18.7	30.0
2.	Toluene D-8	100	714	18824	16.0	30.0
3.	p-Bromofluorobenzene	95	903	13356	23.1	30.0

Tentatively Identified Compounds

	Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1.	1,3-Oxathiolane	60	475	-NQ-		

Environmental Trace Substances Research Center

Volatile Result Summary

Sample Source: Burns & McDonnell

Submitter ID#: D-94

ETSRC ID#: 85120511 Data File#: VOL511

Sample Matrix: Water

Method: U.S.E.P.A. #624

Date Received: December 17, 1985

Date Analyzed: Conc. Units: mcg/L

Analyst: C. Orazio

Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1. Methylene chloride	84	210	2333	9.1	11.9
2. 1,1 Dichloroethylene	96				<MDL
3. 1,1 Dichloroethane	63				<MDL
4. 1,2 Dichloroethylene	96				<MDL
5. Chloroform	83				<MDL
6. 1,2, Dichloroethane	62				<MDL
7. 1,1,1 Trichloroethane	97				<MDL
8. Carbon tetrachloride	117				<MDL
9. Bromodichloromethane	127				<MDL
10. 1,2 Dichloropropane	65				<MDL
11. 1,3 Dichloropropylene	75				<MDL
12. Trichloroethylene	130				<MDL
13. Benzene	78				<MDL
14. cis 1,3 Dichloropropylene	75				<MDL
15. 1,1,2 Trichloroethane	97				<MDL
16. Dibromochloromethane	127				<MDL
17. 2 Chloroethylvinyl ether	63				<MDL
18. Bromoform	173				<MDL
19. Tetrachloroethylene	164				<MDL
20. 1,1,2,2 Tetrachloroethane	83				<MDL
21. Toluene	92				<MDL
22. Chlorobenzene	112				<MDL
23. Ethylbenzene	91				<MDL

Surrogate Results

	Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1.	Benzene D-8	84	529	53026	20.9	30.0
2.	Toluene D-8	100	715	21994	18.7	30.0
3.	p-Bromofluorobenzene	95	906	14013	17.2	30.0

Tentatively Identified Compounds

	Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1.	Acetone	258				

Environmental Trace Substances Research Center

Volatile Result Summary

Sample Source: Burns & McDonnell

Submitter ID#: D-93

ETSRC ID#: 85120510 Data File#: VOL510

Sample Matrix: Water

Method: U.S.E.P.A. #624

Date Received: December 17, 1985

Date Analyzed: Conc. Units: mcg/L

Analyst: C. Orazio

Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1. Methylene chloride	84	211	1731	6.8	10.9
2. 1,1 Dichloroethylene	96				<MDL
3. 1,1 Dichloroethane	63				<MDL
4. 1,2 Dichloroethylene	96				<MDL
5. Chloroform	83				<MDL
6. 1,2, Dichloroethane	62				<MDL
7. 1,1,1 Trichloroethane	97				<MDL
8. Carbon tetrachloride	117				<MDL
9. Bromodichloromethane	127				<MDL
10. 1,2 Dichloropropane	65				<MDL
11. 1,3 Dichloropropylene	75				<MDL
12. Trichloroethylene	130				<MDL
13. Benzene	78				<MDL
14. cis 1,3 Dichloropropylene	75				<MDL
15. 1,1,2 Trichloroethane	97				<MDL
16. Dibromochloromethane	127				<MDL
17. 2 Chloroethylvinyl ether	63				<MDL
18. Bromoform	173				<MDL
19. Tetrachloroethylene	164				<MDL
20. 1,1,2,2 Tetrachloroethane	83				<MDL
21. Toluene	92				<MDL
22. Chlorobenzene	112				<MDL
23. Ethylbenzene	91				<MDL

Surrogate Results

	Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1.	Benzene D-8	84	529	53927	21.3	30.0
2.	Toluene D-8	100	716	24314	20.7	30.0
3.	p-Bromofluorobenzene	95	906	15796	19.4	30.0

Tentatively Identified Compounds

Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc

GROSS ALPHA AND BETA

DECEMBER, 1985

Controls for Environmental Pollution, Inc.
P.O. BOX 5351 • Santa Fe, New Mexico 87502
IN STATE 505/[illegible]
OUT OF STATE 800/545-2188

REPORT OF ANALYSIS

LAB # 85-12-462

SAMPLE IDENTIFICATION	DATE COLLECTED	TYPE OF ANALYSIS	pCi/liter
D 83	12/12/85	Gross Alpha	<2
		Gross Beta	31+/-20
D 85	12/11/85	Gross Alpha	17+/-13
		Gross Beta	23+/-10
D 92	12/12/85	Gross Alpha	19+/-13
		Gross Beta	11+/-10
S 84	12/11/85	Gross Alpha	270+/-114
		Gross Beta	171+/-28

PRIORITY POLLUTANTS

MAY, 1986

ENVIRODYNE
ENGINEERS

12161 Lackland Road,
St. Louis, Missouri 63146
(314) 434-6960

REPORT OF ANALYSIS

CLIENT: BURNS AND McDONNELL
P.O. Box 173
Kansas City, Missouri 64141
ATTN: Ms. Mary Erio

REPORT DATE: July 8, 1986
SAMPLE ANALYZED: 18 groundwater samples for priority pollutants.

DATE RECEIVED: May 20 & 21, 1986
METHODS USED: EPA Approved Methods

PROJ. #: 3060-00377
P.O. #:

VOA COMPOUND	DETECTION LIMITS (ug/l)	S-51 (ug/l)	S-80 (ug/l)	D-83 (ug/l)	D-89 (ug/l)	D-90 (ug/l)
BENZENE	5	ND	ND	ND	ND	ND
BROMOFORM	10	ND	ND	ND	ND	ND
CARBON TETRACHLORIDE	5	ND	ND	ND	ND	ND
CHLOROBENZENE	5	ND	ND	ND	ND	ND
CHLORODIBROMOMETHANE	5	ND	ND	ND	ND	ND
CHLOROETHANE	10	ND	ND	ND	ND	ND
2-CHLOROETHYLVINYL ETHER	10	ND	ND	ND	ND	ND
CHLOROFORM	5	ND	ND	ND	ND	ND
DICHLOROBROMOMETHANE	5	ND	ND	ND	ND	ND
1,1-DICHLOROETHANE	5	ND	ND	ND	ND	ND
1,2-DICHLOROETHANE	1	ND	ND	ND	ND	ND
1,1-DICHLOROETHYLENE	5	ND	ND	ND	ND	ND
1,2-DICHLOROPROPANE	10	ND	ND	ND	ND	ND
1,3-DICHLOROPROPYLENE	5	ND	ND	ND	ND	ND
ETHYL BENZENE	5	ND	ND	ND	ND	ND
METHYL BROMIDE	10	ND	ND	ND	ND	ND
METHYL CHLORIDE	10	ND	ND	ND	ND	ND
METHYLENE CHLORIDE	5	ND	ND	ND	10	6
1,1,2,2-TETRACHLOROETHANE	10	ND	ND	ND	ND	ND
TETRACHLOROETHYLENE	5	ND	ND	ND	ND	ND
TOLUENE	5	ND	ND	ND	ND	ND
1,2-TRANS-DICHLOROETHYLENE	5	ND	ND	ND	ND	ND
1,1,1-TRICHLOROETHANE	5	ND	ND	ND	ND	ND
1,1,2-TRICHLOROETHANE	5	ND	ND	ND	ND	ND
TRICHLOROETHYLENE	5	ND	ND	ND	ND	ND
TRICHLOROFLUOROMETHANE	5	ND	ND	ND	ND	ND
VINYL CHLORIDE	10	ND	ND	ND	ND	ND

SURROGATE COMPOUNDS		PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY
1,2-DICHLOROETHANE-D4		97	98	99	87	94
TOLUENE-D8		89	87	85	104	98
p-BFB		93	90	96	122	108

ND = None Detected.

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REPORT OF ANALYSIS - PAGE 2

CLIENT: BURNS AND McDONNELL
P.O. Box 173
Kansas City, Missouri 64141
ATTN: Ms. Mary Erio
3060-00377

VOA COMPOUND	DETECTION LIMITS (ug/l)	D-91 (ug/l)	D-92 (ug/l)	I-59 (ug/l)	I-66 (ug/l)	D-81 (ug/l)
BENZENE	5	ND	ND	ND	ND	ND
BROMOFORM	10	ND	ND	ND	ND	ND
CARBON TETRACHLORIDE	5	ND	ND	ND	ND	ND
CHLOROBENZENE	5	ND	ND	ND	ND	ND
CHLORODIBROMOMETHANE	5	ND	ND	ND	ND	ND
CHLOROETHANE	10	ND	ND	ND	ND	ND
2-CHLOROETHYLVINYL ETHER	10	ND	ND	ND	ND	ND
CHLOROFORM	5	ND	ND	ND	ND	ND
DICHLOROBROMOMETHANE	5	ND	ND	ND	ND	ND
1,1-DICHLOROETHANE	5	ND	ND	ND	ND	ND
1,2-DICHLOROETHANE	1	ND	ND	ND	ND	ND
1,1-DICHLOROETHYLENE	5	ND	ND	ND	ND	ND
1,2-DICHLOROPROPANE	10	ND	ND	ND	ND	ND
1,3-DICHLOROPROPYLENE	5	ND	ND	ND	ND	ND
ETHYL BENZENE	5	ND	ND	ND	ND	ND
METHYL BROMIDE	10	ND	ND	ND	ND	ND
METHYL CHLORIDE	10	ND	ND	ND	ND	ND
METHYLENE CHLORIDE	5	ND	ND	7	ND	ND
1,1,2,2-TETRACHLOROETHANE	10	ND	ND	ND	ND	ND
TETRACHLOROETHYLENE	5	ND	ND	ND	ND	ND
TOLUENE	5	ND	ND	ND	ND	ND
1,2-TRANS-DICHLOROETHYLENE	5	ND	ND	ND	ND	ND
1,1,1-TRICHLOROETHANE	5	ND	ND	ND	ND	ND
1,1,2-TRICHLOROETHANE	5	ND	ND	ND	ND	ND
TRICHLOROETHYLENE	5	ND	ND	ND	ND	ND
TRICHLOROFLUOROMETHANE	5	ND	ND	ND	ND	ND
VINYL CHLORIDE	10	ND	ND	ND	ND	ND

SURROGATE COMPOUNDS	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY
1,2-DICHLOROETHANE-D4	100	92	92	92	91
TOLUENE-D8	103	95	105	105	103
p-BFB	116	110	106	108	105

ND = None Detected.

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REPORT OF ANALYSIS - PAGE 3

CLIENT: BURNS AND McDONNELL
P.O. Box 173
Kansas City, Missouri 64141
ATTN: Ms. Mary Erio
3060-00377

VOA COMPOUND	DETECTION LIMITS (ug/l)	S-82 (ug/l)	S-84 (ug/l)	D-85 (ug/l)	D-87 (ug/l)	D-88 (ug/l)
BENZENE	5	ND	ND	ND	ND	ND
BROMOFORM	10	ND	ND	ND	ND	ND
CARBON TETRACHLORIDE	5	ND	ND	ND	ND	ND
CHLOROBENZENE	5	ND	ND	ND	ND	ND
CHLORODIBROMOMETHANE	5	ND	ND	ND	ND	ND
CHLOROETHANE	10	ND	ND	ND	ND	ND
2-CHLOROETHYLVINYL ETHER	10	ND	ND	ND	ND	ND
CHLOROFORM	5	ND	ND	ND	ND	ND
DICHLOROBROMOMETHANE	5	ND	ND	ND	ND	ND
1,1-DICHLOROETHANE	5	ND	ND	ND	ND	ND
1,2-DICHLOROETHANE	1	ND	ND	ND	ND	ND
1,1-DICHLOROETHYLENE	5	ND	ND	ND	ND	ND
1,2-DICHLOROPROPANE	10	ND	ND	ND	ND	ND
1,3-DICHLOROPROPYLENE	5	ND	ND	ND	ND	ND
ETHYL BENZENE	5	ND	ND	ND	ND	ND
METHYL BROMIDE	10	ND	ND	ND	ND	ND
METHYL CHLORIDE	10	ND	ND	ND	ND	ND
METHYLENE CHLORIDE	5	ND	ND	ND	ND	ND
1,1,2,2-TETRACHLOROETHANE	10	ND	ND	ND	ND	ND
TETRACHLOROETHYLENE	5	ND	ND	ND	ND	ND
TOLUENE	5	ND	ND	ND	ND	ND
1,2-TRANS-DICHLOROETHYLENE	5	ND	ND	ND	ND	ND
1,1,1-TRICHLOROETHANE	5	ND	ND	ND	ND	ND
1,1,2-TRICHLOROETHANE	5	ND	ND	ND	ND	ND
TRICHLOROETHYLENE	5	ND	ND	ND	ND	ND
TRICHLOROFLUOROMETHANE	5	ND	ND	ND	ND	ND
VINYL CHLORIDE	10	ND	ND	ND	ND	ND

SURROGATE COMPOUNDS	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY
1,2-DICHLOROETHANE-D4	91	90	87	85	87
TOLUENE-D8	105	105	106	108	104
p-BFB	109	107	110	111	110

ND = None Detected.

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REPORT OF ANALYSIS - PAGE 4

CLIENT: BURNS AND McDONNELL
P.O. Box 173
Kansas City, Missouri 64141
ATTN: Ms. Mary Erio
3060-00377

VOA COMPOUND	DETECTION LIMITS (ug/l)	D-93 (ug/l)	D-94 (ug/l)	D-95 (ug/l)	L.BLK. (ug/l)	L.BLK. (ug/l)
BENZENE	5	ND	ND	ND	ND	ND
BROMOFORM	10	ND	ND	ND	ND	ND
CARBON TETRACHLORIDE	5	ND	ND	ND	ND	ND
CHLOROBENZENE	5	ND	ND	ND	ND	ND
CHLORODIBROMOMETHANE	5	ND	ND	ND	ND	ND
CHLOROETHANE	10	ND	ND	ND	ND	ND
2-CHLOROETHYLVINYL ETHER	10	ND	ND	ND	ND	ND
CHLOROFORM	5	ND	ND	ND	ND	ND
DICHLOROBROMOMETHANE	5	ND	ND	ND	ND	ND
1,1-DICHLOROETHANE	5	ND	ND	ND	ND	ND
1,2-DICHLOROETHANE	1	ND	ND	ND	ND	ND
1,1-DICHLOROETHYLENE	5	ND	ND	ND	ND	ND
1,2-DICHLOROPROPANE	10	ND	ND	ND	ND	ND
1,3-DICHLOROPROPYLENE	5	ND	ND	ND	ND	ND
ETHYL BENZENE	5	ND	ND	ND	ND	ND
METHYL BROMIDE	10	ND	ND	ND	ND	ND
METHYL CHLORIDE	10	ND	ND	ND	ND	ND
METHYLENE CHLORIDE	5	ND	ND	ND	17	15
1,1,2,2-TETRACHLOROETHANE	10	ND	ND	ND	ND	ND
TETRACHLOROETHYLENE	5	ND	ND	ND	ND	ND
TOLUENE	5	ND	ND	ND	ND	ND
1,2-TRANS-DICHLOROETHYLENE	5	ND	ND	ND	ND	ND
1,1,1-TRICHLOROETHANE	5	ND	ND	ND	ND	ND
1,1,2-TRICHLOROETHANE	5	ND	ND	ND	ND	ND
TRICHLOROETHYLENE	5	ND	ND	ND	ND	ND
TRICHLOROFLUOROMETHANE	5	ND	ND	ND	ND	ND
VINYL CHLORIDE	10	ND	ND	ND	ND	ND

SURROGATE COMPOUNDS		PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY
1,2-DICHLOROETHANE-D4		86	86	88	96	98
TOLUENE-D8		106	102	102	93	95
p-BFB		108	106	107	86	108

ND = None Detected.

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REPORT OF ANALYSIS — PAGE 5

CLIENT: BURNS AND McDONNELL
P.O. Box 173
Kansas City, Missouri 64141
ATTN: Ms. Mary Erio
3060-00377

ACID COMPOUNDS	DETECTION LIMITS (ug/l)	S-51 (ug/l)	S-80 (ug/l)	D-83 (ug/l)	D-89 (ug/l)	D-90 (ug/l)
2-CHLOROPHENOL	10	ND	ND	ND	ND	ND
2,4-DICHLOROPHENOL	10	ND	ND	ND	ND	ND
2,4-DIMETHYLPHENOL	10	ND	ND	ND	ND	ND
4,6-DINITRO-o-CRESOL	20	ND	ND	ND	ND	ND
2,4-DINITROPHENOL	50	ND	ND	ND	ND	ND
2-NITROPHENOL	20	ND	ND	ND	ND	ND
4-NITROPHENOL	50	ND	ND	ND	ND	ND
p-CHLORO-m-CRESOL	10	ND	ND	ND	ND	ND
PENTACHLOROPHENOL	10	ND	ND	ND	ND	ND
PHENOL	10	ND	ND	ND	ND	ND
2,4,6-TRICHLOROPHENOL	10	ND	ND	ND	ND	ND

SURROGATE COMPOUNDS	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY
2-F-PHENOL	59	45	57	39	104
PHENOL-D6	48	37	50	31	43
2,4,6-TRIBROMOPHENOL	84	75	78	77	86

BASE/NEUTRAL COMPOUNDS	DETECTION LIMITS (ug/l)	S-51 (ug/l)	S-80 (ug/l)	D-83 (ug/l)	D-89 (ug/l)	D-90 (ug/l)
ACENAPHTHENE	10	ND	ND	ND	ND	ND
ACENAPHTHYLENE	10	ND	ND	ND	ND	ND
ANTHRACENE	10	ND	ND	ND	ND	ND
BENZO(a)ANTHRACENE	10	ND	ND	ND	ND	ND
BENZO(a)PYRENE	10	ND	ND	ND	ND	ND
3,4-BENZOFLUORANTHENE	10	ND	ND	ND	ND	ND
BENZO(ghi)PERYLENE	10	ND	ND	ND	ND	ND
BENZO(k)FLUORANTHENE	10	ND	ND	ND	ND	ND
BIS(2-CHLOROETHOXY)METHANE	10	ND	ND	ND	ND	ND

ND = Not Detected

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REPORT OF ANALYSIS - PAGE 6

CLIENT: BURNS AND McDONNELL
P.O. Box 173
Kansas City, Missouri 64141
ATTN: Ms. Mary Erio
3060-00377

BASE/NEUTRAL COMPOUNDS CONT'D	DETECTION LIMITS (ug/l)	S-51 (ug/l)	S-80 (ug/l)	D-83 (ug/l)	D-89 (ug/l)	D-90 (ug/l)
BIS(2-CHLOROETHYL)ETHER	10	ND	ND	ND	ND	ND
BIS(2-CHLOROISOPROPYL)ETHER	10	ND	ND	ND	ND	ND
BIS(2-ETHYLHEXYL)PHTHALATE	10	ND	ND	ND	25	ND
4-BROMOPHENYL PHENYL ETHER	10	ND	ND	ND	ND	ND
BUTYL BENZYL PHTHALATE	10	ND	ND	ND	ND	ND
2-CHLORONAPHTHALENE	10	ND	ND	ND	ND	ND
4-CHLOROPHENYL PHENYL ETHER	10	ND	ND	ND	ND	ND
CHRYSENE	10	ND	ND	ND	ND	ND
DIBENZO(a,h)ANTHRACENE	10	ND	ND	ND	ND	ND
1,2-DICHLOROBENZENE	10	ND	ND	ND	ND	ND
1,3-DICHLOROBENZENE	10	ND	ND	ND	ND	ND
1,4-DICHLOROBENZENE	10	ND	ND	ND	ND	ND
3,3'-DICHLOROBENZIDINE	20	ND	ND	ND	ND	ND
DIETHYL PHTHALATE	10	ND	ND	ND	ND	ND
DIMETHYL PHTHALATE	10	ND	ND	ND	ND	ND
DI-n-BUTYL PHTHALATE	10	ND	ND	ND	ND	ND
2,4-DINITROTOLUENE	10	ND	ND	ND	ND	ND
2,6-DINITROTOLUENE	10	ND	ND	ND	ND	ND
DI-n-OCTYL PHTHALATE	10	ND	ND	ND	ND	ND
BENZO(b)FLUORANTHENE	10	ND	ND	ND	ND	ND
1,2-DIPHENYLHYDRAZINE	20	ND	ND	ND	ND	ND
FLUORANTHENE	10	ND	ND	ND	ND	ND
FLUORENE	10	ND	ND	ND	ND	ND
HEXACHLOROBENZENE	10	ND	ND	ND	ND	ND
HEXACHLOROBUTADIENE	10	ND	ND	ND	ND	ND
HEXACHLOROCYCLOPENTADIENE	10	ND	ND	ND	ND	ND
HEXACHLOROETHANE	10	ND	ND	ND	ND	ND
INDENO(1,2,3-cd)PYRENE	10	ND	ND	ND	ND	ND
ISOPHORONE	10	ND	ND	ND	ND	ND
NAPHTHALENE	10	ND	ND	ND	ND	ND
NITROBENZENE	10	ND	ND	ND	ND	ND
N-NITROSODI-n-PROPYLAMINE	10	ND	ND	ND	ND	ND
N-NITROSODIPHENYLAMINE	10	ND	ND	ND	ND	ND
PHENANTHRENE	10	ND	ND	ND	ND	ND
PYRENE	10	ND	ND	ND	ND	ND
1,2,4-TRICHLOROBENZENE	10	ND	ND	ND	ND	ND

ND = Not Detected

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CLIENT: BURNS AND McDONNELL
P.O. Box 173
Kansas City, Missouri 64141
ATTN: Ms. Mary Erio
3060-00377

BASE/NEUTRAL SURROGATE COMPOUNDS	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY
NITROBENZENE-D5	59	55	66	61	43
2-FLUOROBIPHENYL	67	62	86	72	48
TERPHENYL-D14	98	73	94	90	107

PESTICIDES	DETECTION LIMITS (ug/l)	S-51 (ug/l)	S-80 (ug/l)	D-83 (ug/l)	D-89 (ug/l)	D-90 (ug/l)
ALDRIN	0.0018	ND	ND	ND	ND	ND
ALPHA-BHC	0.0015	ND	ND	ND	ND	ND
BETA-BHC	0.0023	ND	ND	ND	ND	ND
GAMMA-BHC (LINDANE)	0.0019	ND	ND	ND	ND	ND
DELTA-BHC	0.0024	ND	ND	ND	ND	ND
CHLORDANE	0.0148	ND	ND	ND	ND	ND
4,4'-DDT	0.0028	ND	ND	ND	ND	ND
4,4'-DDE	0.0015	ND	ND	ND	ND	ND
4,4'-DDD	0.0015	ND	ND	ND	ND	ND
DIELDRIN	0.0019	ND	ND	ND	ND	ND
ALPHA-ENDOSULFAN	0.0027	ND	ND	ND	ND	ND
BETA-ENDOSULFAN	0.0017	ND	ND	ND	ND	ND
ENDOSULFAN SULFATE	0.0021	ND	ND	ND	ND	ND
ENDRIN	0.0022	ND	ND	ND	ND	ND
ENDRIN ALDEHYDE	0.0026	ND	ND	ND	ND	ND
HEPTACHLOR	0.0019	ND	ND	ND	ND	ND
HEPTACHLOR EPOXIDE	0.0019	ND	ND	ND	ND	ND
PCB-1242	0.036	ND	ND	ND	ND	ND
PCB-1254	0.013	ND	ND	ND	ND	ND
PCB-1221	0.133	ND	ND	ND	ND	ND
PCB-1232	0.062	ND	ND	ND	ND	ND
PCB-1248	0.023	ND	ND	ND	ND	ND
PCB-1260	0.012	ND	ND	ND	ND	ND
PCB-1016	0.034	ND	ND	ND	ND	ND
TOXAPHENE	0.437	ND	ND	ND	ND	ND

ND = Not Detected

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ENGINEERS

REPORT OF ANALYSIS - PAGE 8

CLIENT: BURNS AND McDONNELL REVISED 8/19/86
P.O. Box 173
Kansas City, Missouri 64141
ATTN: Ms. Mary Erio
3060-00377

ACID COMPOUNDS	DETECTION LIMITS (ug/l)	D-91 (ug/l)	D-92 (ug/l)	I-59 (ug/l)	I-66 (ug/l)	D-81 (ug/l)
2-CHLOROPHENOL	10	ND	ND	ND	ND	ND
2,4-DICHLOROPHENOL	10	ND	ND	ND	ND	ND
2,4-DIMETHYLPHENOL	10	ND	ND	ND	ND	ND
4,6-DINITRO-o-CRESOL	20	ND	ND	ND	ND	ND
2,4-DINITROPHENOL	50	ND	ND	ND	ND	ND
2-NITROPHENOL	20	ND	ND	ND	ND	ND
4-NITROPHENOL	50	ND	ND	ND	ND	ND
p-CHLORO-m-CRESOL	10	ND	ND	ND	ND	ND
PENTACHLOROPHENOL	10	ND	ND	ND	ND	ND
PHENOL	10	ND	ND	ND	ND	ND
2,4,6-TRICHLOROPHENOL	10	ND	ND	ND	ND	ND

SURROGATE COMPOUNDS	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY
2-F-PHENOL	31	46	48	45	29
PHENOL-D6	26	34	44	38	22
2,4,6-TRIBROMOPHENOL	38	55	64	79	29

BASE/NEUTRAL COMPOUNDS	DETECTION LIMITS (ug/l)	D-91 (ug/l)	D-92 (ug/l)	I-59 (ug/l)	I-66 (ug/l)	D-81 (ug/l)
ACENAPHTHENE	10	ND	ND	ND	ND	ND
ACENAPHTHYLENE	10	ND	ND	ND	ND	ND
ANTHRACENE	10	ND	ND	ND	ND	ND
BENZO(a)ANTHRACENE	10	ND	ND	ND	ND	ND
BENZO(a)PYRENE	10	ND	ND	ND	ND	ND
3,4-BENZOFLUORANTHENE	10	ND	ND	ND	ND	ND
BENZO(ghi)PERYLENE	10	ND	ND	ND	ND	ND
BENZO(k)FLUORANTHENE	10	ND	ND	ND	ND	ND
BIS(2-CHLOROETHOXY)METHANE	10	ND	ND	ND	ND	ND

ND = Not Detected

John J. [illegible]

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CLIENT: BURNS AND McDONNELL
P.O. Box 173
Kansas City, Missouri 64141
ATTN: Ms. Mary Erio
3060-00377

BASE/NEUTRAL COMPOUNDS CONT'D	DETECTION LIMITS (ug/l)	D-91 (ug/l)	D-92 (ug/l)	I-59 (ug/l)	I-66 (ug/l)	D-81 (ug/l)
BIS(2-CHLOROETHYL)ETHER	10	ND	ND	ND	ND	ND
BIS(2-CHLOROISOPROPYL)ETHER	10	ND	ND	ND	ND	ND
BIS(2-ETHYLHEXYL)PHTHALATE	10	ND	ND	ND	ND	ND
4-BROMOPHENYL PHENYL ETHER	10	ND	ND	ND	ND	ND
BUTYL BENZYL PHTHALATE	10	ND	ND	ND	ND	ND
2-CHLORONAPHTHALENE	10	ND	ND	ND	ND	ND
4-CHLOROPHENYL PHENYL ETHER	10	ND	ND	ND	ND	ND
CHRYSENE	10	ND	ND	ND	ND	ND
DIBENZO(a,h)ANTHRACENE	10	ND	ND	ND	ND	ND
1,2-DICHLOROBENZENE	10	ND	ND	ND	ND	ND
1,3-DICHLOROBENZENE	10	ND	ND	ND	ND	ND
1,4-DICHLOROBENZENE	10	ND	ND	ND	ND	ND
3,3'-DICHLOROBENZIDINE	20	ND	ND	ND	ND	ND
DIETHYL PHTHALATE	10	ND	ND	ND	ND	ND
DIMETHYL PHTHALATE	10	ND	ND	ND	ND	ND
DI-n-BUTYL PHTHALATE	10	ND	ND	ND	ND	ND
2,4-DINITROTOLUENE	10	ND	ND	ND	ND	ND
2,6-DINITROTOLUENE	10	ND	ND	ND	ND	ND
DI-n-OCTYL PHTHALATE	10	ND	ND	ND	ND	ND
BENZO(b)FLUORANTHENE	10	ND	ND	ND	ND	ND
1,2-DIPHENYLHYDRAZINE	20	ND	ND	ND	ND	ND
FLUORANTHENE	10	ND	ND	ND	ND	ND
FLUORENE	10	ND	ND	ND	ND	ND
HEXACHLOROBENZENE	10	ND	ND	ND	ND	ND
HEXACHLOROBUTADIENE	10	ND	ND	ND	ND	ND
HEXACHLOROCYCLOPENTADIENE	10	ND	ND	ND	ND	ND
HEXACHLOROETHANE	10	ND	ND	ND	ND	ND
INDENO(1,2,3-cd)PYRENE	10	ND	ND	ND	ND	ND
ISOPHORONE	10	ND	ND	ND	ND	ND
NAPHTHALENE	10	ND	ND	ND	ND	ND
NITROBENZENE	10	ND	ND	ND	ND	ND
N-NITROSODI-n-PROPYLAMINE	10	ND	ND	ND	ND	ND
N-NITROSODIPHENYLAMINE	10	ND	ND	ND	ND	ND
PHENANTHRENE	10	ND	ND	ND	ND	ND
PYRENE	10	ND	ND	ND	ND	ND
1,2,4-TRICHLOROBENZENE	10	ND	ND	ND	ND	ND

ND = Not Detected

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ENGINEERS

CLIENT: BURNS AND McDONNELL
P.O. Box 173
Kansas City, Missouri 64141
ATTN: Ms. Mary Erio
3060-00377

BASE/NEUTRAL SURROGATE COMPOUNDS	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY
NITROBENZENE-D5	30	51	59	58	44
2-FLUOROBIPHENYL	36	60	73	71	48
TERPHENYL-D14	78	73	81	87	99

PESTICIDES	DETECTION LIMITS (ug/l)	D-91 (ug/l)	D-92 (ug/l)	I-59 (ug/l)	I-66 (ug/l)	D-81 (ug/l)
ALDRIN	0.0018	ND	ND	ND	ND	ND
ALPHA-BHC	0.0015	ND	ND	ND	ND	ND
BETA-BHC	0.0023	ND	ND	ND	ND	ND
GAMMA-BHC (LINDANE)	0.0019	ND	ND	ND	ND	ND
DELTA-BHC	0.0024	ND	ND	ND	ND	ND
CHLORDANE	0.0148	ND	ND	ND	ND	ND
4,4'-DDT	0.0028	ND	ND	ND	ND	ND
4,4'-DDE	0.0015	ND	ND	ND	ND	ND
4,4'-DDD	0.0015	ND	ND	ND	ND	ND
DIELDRIN	0.0019	ND	ND	ND	ND	ND
ALPHA-ENDOSULFAN	0.0027	ND	ND	ND	ND	ND
BETA-ENDOSULFAN	0.0017	ND	ND	ND	ND	ND
ENDOSULFAN SULFATE	0.0021	ND	ND	ND	ND	ND
ENDRIN	0.0022	ND	ND	ND	ND	ND
ENDRIN ALDEHYDE	0.0026	ND	ND	ND	ND	ND
HEPTACHLOR	0.0019	ND	ND	ND	ND	ND
HEPTACHLOR EPOXIDE	0.0019	ND	ND	ND	ND	ND
PCB-1242	0.036	ND	ND	ND	ND	ND
PCB-1254	0.013	ND	ND	ND	ND	ND
PCB-1221	0.133	ND	ND	ND	ND	ND
PCB-1232	0.062	ND	ND	ND	ND	ND
PCB-1248	0.023	ND	ND	ND	ND	ND
PCB-1260	0.012	ND	ND	ND	ND	ND
PCB-1016	0.034	ND	ND	ND	ND	ND
TOXAPHENE	0.437	ND	ND	ND	ND	ND

ND = Not Detected

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ENGINEERS

REPORT OF ANALYSIS - PAGE 11

CLIENT: BURNS AND McDONNELL REVISED 8/19/86
P.O. Box 173
Kansas City, Missouri 64141
ATTN: Ms. Mary Erio
3060-00377

ACID COMPOUNDS	DETECTION LIMITS (ug/l)	S-82 (ug/l)	S-84 (ug/l)	D-85 (ug/l)	D-87 (ug/l)	D-88 (ug/l)
2-CHLOROPHENOL	10	ND	ND	ND	ND	ND
2,4-DICHLOROPHENOL	10	ND	ND	ND	ND	ND
2,4-DIMETHYLPHENOL	10	ND	ND	ND	ND	ND
4,6-DINITRO-o-CRESOL	20	ND	ND	ND	ND	ND
2,4-DINITROPHENOL	50	ND	ND	ND	ND	ND
2-NITROPHENOL	20	ND	ND	ND	ND	ND
4-NITROPHENOL	50	ND	ND	ND	ND	ND
p-CHLORO-m-CRESOL	10	ND	ND	ND	ND	ND
PENTACHLOROPHENOL	10	ND	ND	ND	ND	ND
PHENOL	10	ND	ND	ND	ND	ND
2,4,6-TRICHLOROPHENOL	10	ND	ND	ND	ND	ND

SURROGATE COMPOUNDS	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY
2-F-PHENOL	22	35	30	42	30
PHENOL-D6	21	28	27	36	23
2,4,6-TRIBROMOPHENOL	34	43	38	71	36

BASE/NEUTRAL COMPOUNDS	DETECTION LIMITS (ug/l)	S-82 (ug/l)	S-84 (ug/l)	D-85 (ug/l)	D-87 (ug/l)	D-88 (ug/l)
ACENAPHTHENE	10	ND	ND	ND	ND	ND
ACENAPHTHYLENE	10	ND	ND	ND	ND	ND
ANTHRACENE	10	ND	ND	ND	ND	ND
BENZO(a)ANTHRACENE	10	ND	ND	ND	ND	ND
BENZO(a)PYRENE	10	ND	ND	ND	ND	ND
3,4-BENZOFLUORANTHENE	10	ND	ND	ND	ND	ND
BENZO(ghi)PERYLENE	10	ND	ND	ND	ND	ND
BENZO(k)FLUORANTHENE	10	ND	ND	ND	ND	ND
BIS(2-CHLOROETHOXY)METHANE	10	ND	ND	ND	ND	ND

ND = Not Detected

John J. Cain [signature]

ENVIRODYNE
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REPORT OF ANALYSIS - PAGE 12

CLIENT: BURNS AND McDONNELL
P.O. Box 173
Kansas City, Missouri 64141
ATTN: Ms. Mary Erio
3060-00377

BASE/NEUTRAL COMPOUNDS CONT'D	DETECTION LIMITS (ug/l)	S-82 (ug/l)	S-84 (ug/l)	D-85 (ug/l)	D-87 (ug/l)	D-88 (ug/l)
BIS(2-CHLOROETHYL)ETHER	10	ND	ND	ND	ND	ND
BIS(2-CHLOROISOPROPYL)ETHER	10	ND	ND	ND	ND	ND
BIS(2-ETHYLHEXYL)PHTHALATE	10	ND	ND	ND	ND	ND
4-BROMOPHENYL PHENYL ETHER	10	ND	ND	ND	ND	ND
BUTYL BENZYL PHTHALATE	10	ND	ND	ND	ND	ND
2-CHLORONAPHTHALENE	10	ND	ND	ND	ND	ND
4-CHLOROPHENYL PHENYL ETHER	10	ND	ND	ND	ND	ND
CHRYSENE	10	ND	ND	ND	ND	ND
DIBENZO(a,h)ANTHRACENE	10	ND	ND	ND	ND	ND
1,2-DICHLOROBENZENE	10	ND	ND	ND	ND	ND
1,3-DICHLOROBENZENE	10	ND	ND	ND	ND	ND
1,4-DICHLOROBENZENE	10	ND	ND	ND	ND	ND
3,3'-DICHLOROBENZIDINE	20	ND	ND	ND	ND	ND
DIETHYL PHTHALATE	10	ND	ND	ND	ND	ND
DIMETHYL PHTHALATE	10	ND	ND	ND	ND	ND
DI-n-BUTYL PHTHALATE	10	ND	ND	ND	ND	ND
2,4-DINITROTOLUENE	10	ND	ND	ND	ND	ND
2,6-DINITROTOLUENE	10	ND	ND	ND	ND	ND
DI-n-OCTYL PHTHALATE	10	ND	ND	ND	ND	ND
BENZO(b)FLUORANTHENE	10	ND	ND	ND	ND	ND
1,2-DIPHENYLHYDRAZINE	20	ND	ND	ND	ND	ND
FLUORANTHENE	10	ND	ND	ND	ND	ND
FLUORENE	10	ND	ND	ND	ND	ND
HEXACHLOROBENZENE	10	ND	ND	ND	ND	ND
HEXACHLOROBUTADIENE	10	ND	ND	ND	ND	ND
HEXACHLOROCYCLOPENTADIENE	10	ND	ND	ND	ND	ND
HEXACHLOROETHANE	10	ND	ND	ND	ND	ND
INDENO(1,2,3-cd)PYRENE	10	ND	ND	ND	ND	ND
ISOPHORONE	10	ND	ND	ND	ND	ND
NAPHTHALENE	10	ND	ND	ND	ND	ND
NITROBENZENE	10	ND	ND	ND	ND	ND
N-NITROSODI-n-PROPYLAMINE	10	ND	ND	ND	ND	ND
N-NITROSODIPHENYLAMINE	10	ND	ND	ND	ND	ND
PHENANTHRENE	10	ND	ND	ND	ND	ND
PYRENE	10	ND	ND	ND	ND	ND
1,2,4-TRICHLOROBENZENE	10	ND	ND	ND	ND	ND

ND = Not Detected

ENVIRODYNE
ENGINEERS

CLIENT: BURNS AND McDONNELL
P.O. Box 173
Kansas City, Missouri 64141
ATTN: Ms. Mary Erio
3060-00377

BASE/NEUTRAL SURROGATE COMPOUNDS	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY
NITROBENZENE-D5	72	72	39	73	84
2-FLUOROBIPHENYL	79	73	58	77	87
TERPHENYL-D14	96	85	91	92	91

PESTICIDES	DETECTION LIMITS (ug/l)	S-82 (ug/l)	S-84 (ug/l)	D-85 (ug/l)	D-87 (ug/l)	D-88 (ug/l)
ALDRIN	0.0018	ND	ND	ND	ND	ND
ALPHA-BHC	0.0015	ND	ND	ND	ND	ND
BETA-BHC	0.0023	ND	ND	ND	ND	ND
GAMMA-BHC (LINDANE)	0.0019	ND	ND	ND	ND	ND
DELTA-BHC	0.0024	ND	ND	ND	ND	ND
CHLORDANE	0.0148	ND	ND	ND	ND	ND
4,4'-DDT	0.0028	ND	ND	ND	ND	ND
4,4'-DDE	0.0015	ND	ND	ND	ND	ND
4,4'-DDD	0.0015	ND	ND	ND	ND	ND
DIELDRIN	0.0019	ND	ND	ND	ND	ND
ALPHA-ENDOSULFAN	0.0027	ND	ND	ND	ND	ND
BETA-ENDOSULFAN	0.0017	ND	ND	ND	ND	ND
ENDOSULFAN SULFATE	0.0021	ND	ND	ND	ND	ND
ENDRIN	0.0022	ND	ND	ND	ND	ND
ENDRIN ALDEHYDE	0.0026	ND	ND	ND	ND	ND
HEPTACHLOR	0.0019	ND	ND	ND	ND	ND
HEPTACHLOR EPOXIDE	0.0019	ND	ND	ND	ND	ND
PCB-1242	0.036	ND	ND	ND	ND	ND
PCB-1254	0.013	ND	ND	ND	ND	ND
PCB-1221	0.133	ND	ND	ND	ND	ND
PCB-1232	0.062	ND	ND	ND	ND	ND
PCB-1248	0.023	ND	ND	ND	ND	ND
PCB-1260	0.012	ND	ND	ND	ND	ND
PCB-1016	0.034	ND	ND	ND	ND	ND
TOXAPHENE	0.437	ND	ND	ND	ND	ND

ND = Not Detected

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ENGINEERS

CLIENT: BURNS AND McDONNELL
P.O. Box 173
Kansas City, Missouri 64141
ATTN: Ms. Mary Erio
3060-00377

ACID COMPOUNDS	DETECTION LIMITS (ug/l)	D-93 (ug/l)	D-94 (ug/l)	D-95 (ug/l)	L.BLK. (ug/l)	L.BLK. (ug/l)
2-CHLOROPHENOL	10	ND	ND	ND	ND	ND
2,4-DICHLOROPHENOL	10	ND	ND	ND	ND	ND
2,4-DIMETHYLPHENOL	10	ND	ND	ND	ND	ND
4,6-DINITRO-o-CRESOL	20	ND	ND	ND	ND	ND
2,4-DINITROPHENOL	50	ND	ND	ND	ND	ND
2-NITROPHENOL	20	ND	ND	ND	ND	ND
4-NITROPHENOL	50	ND	ND	ND	ND	ND
p-CHLORO-m-CRESOL	10	ND	ND	ND	ND	ND
PENTACHLOROPHENOL	10	ND	ND	ND	ND	ND
PHENOL	10	ND	ND	ND	ND	ND
2,4,6-TRICHLOROPHENOL	10	ND	ND	ND	ND	ND

SURROGATE COMPOUNDS	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY
2-F-PHENOL	63	49	59	61	56
PHENOL-D6	53	39	44	50	46
2,4,6-TRIBROMOPHENOL	92	87	92	93	93

BASE/NEUTRAL COMPOUNDS	DETECTION LIMITS (ug/l)	D-93 (ug/l)	D-94 (ug/l)	D-95 (ug/l)	L.BLK. (ug/l)	L.BLK. (ug/l)
ACENAPHTHENE	10	ND	ND	ND	ND	ND
ACENAPHTHYLENE	10	ND	ND	ND	ND	ND
ANTHRACENE	10	ND	ND	ND	ND	ND
BENZO(a)ANTHRACENE	10	ND	ND	ND	ND	ND
BENZO(a)PYRENE	10	ND	ND	ND	ND	ND
3,4-BENZOFLUORANTHENE	10	ND	ND	ND	ND	ND
BENZO(ghi)PERYLENE	10	ND	ND	ND	ND	ND
BENZO(k)FLUORANTHENE	10	ND	ND	ND	ND	ND
BIS(2-CHLOROETHOXY)METHANE	10	ND	ND	ND	ND	ND

ND = Not Detected

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BASE/NEUTRAL COMPOUNDS CONT'D	DETECTION LIMITS (ug/l)	D-93 (ug/l)	D-94 (ug/l)	D-95 (ug/l)	L.BLK. (ug/l)	L.BLK. (ug/l)
BIS(2-CHLOROETHYL)ETHER	10	ND	ND	ND	ND	ND
BIS(2-CHLOROISOPROPYL)ETHER	10	ND	ND	ND	ND	ND
BIS(2-ETHYLHEXYL)PHTHALATE	10	ND	ND	ND	ND	ND
4-BROMOPHENYL PHENYL ETHER	10	ND	ND	ND	ND	ND
BUTYL BENZYL PHTHALATE	10	ND	ND	ND	ND	ND
2-CHLORONAPHTHALENE	10	ND	ND	ND	ND	ND
4-CHLOROPHENYL PHENYL ETHER	10	ND	ND	ND	ND	ND
CHRYSENE	10	ND	ND	ND	ND	ND
DIBENZO(a,h)ANTHRACENE	10	ND	ND	ND	ND	ND
1,2-DICHLOROBENZENE	10	ND	ND	ND	ND	ND
1,3-DICHLOROBENZENE	10	ND	ND	ND	ND	ND
1,4-DICHLOROBENZENE	10	ND	ND	ND	ND	ND
3,3'-DICHLOROBENZIDINE	20	ND	ND	ND	ND	ND
DIETHYL PHTHALATE	10	ND	ND	ND	ND	ND
DIMETHYL PHTHALATE	10	ND	ND	ND	ND	ND
DI-n-BUTYL PHTHALATE	10	ND	ND	ND	ND	ND
2,4-DINITROTOLUENE	10	ND	ND	ND	ND	ND
2,6-DINITROTOLUENE	10	ND	ND	ND	ND	ND
DI-n-OCTYL PHTHALATE	10	ND	ND	ND	ND	ND
BENZO(b)FLUORANTHENE	10	ND	ND	ND	ND	ND
1,2-DIPHENYLHYDRAZINE	20	ND	ND	ND	ND	ND
FLUORANTHENE	10	ND	ND	ND	ND	ND
FLUORENE	10	ND	ND	ND	ND	ND
HEXACHLOROBENZENE	10	ND	ND	ND	ND	ND
HEXACHLOROBUTADIENE	10	ND	ND	ND	ND	ND
HEXACHLOROCYCLOPENTADIENE	10	ND	ND	ND	ND	ND
HEXACHLOROETHANE	10	ND	ND	ND	ND	ND
INDENO(1,2,3-cd)PYRENE	10	ND	ND	ND	ND	ND
ISOPHORONE	10	ND	ND	ND	ND	ND
NAPHTHALENE	10	ND	ND	ND	ND	ND
NITROBENZENE	10	ND	ND	ND	ND	ND
N-NITROSODI-n-PROPYLAMINE	10	ND	ND	ND	ND	ND
N-NITROSODIPHENYLAMINE	10	ND	ND	ND	ND	ND
PHENANTHRENE	10	ND	ND	ND	ND	ND
PYRENE	10	ND	ND	ND	ND	ND
1,2,4-TRICHLOROBENZENE	10	ND	ND	ND	ND	ND

ND = Not Detected

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REPORT OF ANALYSIS - PAGE 16

CLIENT: BURNS AND McDONNELL
P.O. Box 173
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ATTN: Ms. Mary Erio
3060-00377

BASE/NEUTRAL SURROGATE COMPOUNDS	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY	PERCENT RECVRY
NITROBENZENE-D5	77	71	54	68	53
2-FLUOROBIPHENYL	85	76	60	73	60
TERPHENYL-D14	92	90	81	85	79

PESTICIDES	DETECTION LIMITS (ug/l)	D-93 (ug/l)	D-94 (ug/l)	D-95 (ug/l)	L.BLK. (ug/l)	L.BLK. (ug/l)
ALDRIN	0.0018	ND	ND	ND	ND	ND
ALPHA-BHC	0.0015	ND	ND	ND	ND	ND
BETA-BHC	0.0023	ND	ND	ND	ND	ND
GAMMA-BHC (LINDANE)	0.0019	ND	ND	ND	ND	ND
DELTA-BHC	0.0024	ND	ND	ND	ND	ND
CHLORDANE	0.0148	ND	ND	ND	ND	ND
4,4'-DDT	0.0028	ND	ND	ND	ND	ND
4,4'-DDE	0.0015	ND	ND	ND	ND	ND
4,4'-DDD	0.0015	ND	ND	ND	ND	ND
DIELDRIN	0.0019	ND	ND	ND	ND	ND
ALPHA-ENDOSULFAN	0.0027	ND	ND	ND	ND	ND
BETA-ENDOSULFAN	0.0017	ND	ND	ND	ND	ND
ENDOSULFAN SULFATE	0.0021	ND	ND	ND	ND	ND
ENDRIN	0.0022	ND	ND	ND	ND	ND
ENDRIN ALDEHYDE	0.0026	ND	ND	ND	ND	ND
HEPTACHLOR	0.0019	ND	ND	ND	ND	ND
HEPTACHLOR EPOXIDE	0.0019	ND	ND	ND	ND	ND
PCB-1242	0.036	ND	ND	ND	ND	ND
PCB-1254	0.013	ND	ND	ND	ND	ND
PCB-1221	0.133	ND	ND	ND	ND	ND
PCB-1232	0.062	ND	ND	ND	ND	ND
PCB-1248	0.023	ND	ND	ND	ND	ND
PCB-1260	0.012	ND	ND	ND	ND	ND
PCB-1016	0.034	ND	ND	ND	ND	ND
TOXAPHENE	0.437	ND	ND	ND	ND	ND

ND = Not Detected

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ATTN: Ms. Mary Erio
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GROUNDWATER SAMPLE	TOTAL CYANIDE (ug/l)	TOTAL PHENOLS (mg/l)
S-51	< 5	< 0.002
S-80	< 5	< 0.002
D-83	< 5	< 0.002
D-89	< 5	< 0.002
D-90	7	< 0.002
D-91	< 5	< 0.002
D-92	< 5	< 0.002
I-59	< 5	< 0.002
I-66	< 5	< 0.002
D-81	< 5	< 0.002
S-82	< 5	< 0.002
S-84	< 5	< 0.002
D-85	< 5	< 0.002
D-87	< 5	< 0.002
D-88	< 5	< 0.002
D-93	< 5	< 0.002
D-94	< 5	< 0.002
D-95	< 5	< 0.002

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CLIENT: BURNS AND McDONNELL — REVISED JULY 31, 1986
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Kansas City, Missouri 64141
ATTN: Ms. Mary Erio
3060-00377

GROUNDWATER SAMPLE	Sb (mg/l)	As (mg/l)	Be (mg/l)	Cd (mg/l)	Cr (mg/l)	Cu (mg/l)	Pb (mg/l)
S-51	0.017	< 0.002	< 0.001	< 0.001	< 0.004	< 0.004	< 0.005
S-80	0.029	< 0.002	< 0.001	< 0.001	< 0.004	0.005	< 0.005
D-83	0.034	< 0.002	< 0.001	< 0.001	< 0.004	0.004	< 0.005
D-89	0.026	< 0.002	< 0.001	< 0.001	< 0.004	< 0.004	< 0.005
D-90	0.008	< 0.002	< 0.001	< 0.001	< 0.004	0.007	< 0.005
D-91	0.026	0.004	< 0.001	< 0.001	< 0.004	0.01	0.013
D-92	0.020	< 0.002	< 0.001	< 0.001	< 0.004	0.009	< 0.005
I-59	0.035	< 0.002	< 0.001	< 0.001	< 0.004	0.011	< 0.005
I-66	0.013	< 0.002	< 0.001	< 0.001	< 0.004	0.009	< 0.005
D-81	0.034	< 0.002	< 0.001	< 0.001	< 0.004	0.008	< 0.005
S-82	0.040	< 0.002	< 0.001	< 0.001	< 0.004	0.04	< 0.005
S-84	0.024	0.009	< 0.001	0.001	< 0.004	0.01	< 0.005
D-85	0.025	0.008	< 0.001	< 0.001	< 0.004	0.005	< 0.005
D-87	0.021	< 0.002	< 0.001	< 0.001	< 0.004	0.011	< 0.005
D-88	0.041	0.009	< 0.001	< 0.001	< 0.004	0.007	< 0.005
D-93	0.116	< 0.002	< 0.001	< 0.001	< 0.004	0.01	< 0.005
D-94	0.022	< 0.002	< 0.001	< 0.001	< 0.004	0.004	0.007
D-95	0.011	0.006	< 0.001	< 0.001	< 0.004	0.004	< 0.005

Sb = Antimony; As = Arsenic; Be = Beryllium; Cd = Cadmium; Cr = Chromium
Cu = Copper; Pb = Lead

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CLIENT: BURNS AND McDONNELL REVISED JULY 31, 1986
P.O. Box 173
Kansas City, Missouri 64141
ATTN: Ms. Mary Erio
3060-00377

GROUNDWATER SAMPLE	Hg (ug/l)	Ni (mg/l)	Se (mg/l)	Ag (mg/l)	Tl (mg/l)	Zn (mg/l)
S-51	< 0.2	< 0.004	< 0.002	0.002	0.005	2
S-80	< 0.2	< 0.004	< 0.002	0.004	0.010	0.01
D-83	< 0.2	0.011	< 0.002	0.005	0.013	0.02
D-89	< 0.2	0.007	< 0.002	0.004	0.010	0.04
D-90	< 0.2	0.007	< 0.002	< 0.002	0.005	< 0.002
D-91	< 0.2	0.024	< 0.002	0.004	0.009	0.02
D-92	< 0.2	0.019	< 0.002	0.007	0.015	0.02
I-59	< 0.2	0.02	< 0.002	0.007	0.019	0.01
I-66	< 0.2	< 0.004	< 0.002	0.003	0.009	0.01
D-81	< 0.2	0.006	< 0.002	0.005	0.012	0.02
S-82	< 0.2	0.062	< 0.002	0.006	0.016	0.03
S-84	< 0.2	0.008	< 0.002	0.004	0.007	0.03
D-85	< 0.2	0.013	< 0.002	0.005	0.009	0.01
D-87	< 0.2	0.015	< 0.002	0.006	0.013	0.01
D-88	< 0.2	0.011	< 0.002	0.005	0.009	0.04
D-93	< 0.2	0.012	< 0.002	0.004	0.027	< 0.002
D-94	< 0.2	< 0.004	< 0.002	0.003	0.008	0.01
D-95	< 0.2	0.004	< 0.002	0.003	0.008	0.07

Hg = Mercury; Ni = Nickel; Se = Selenium; Ag = Silver; Tl = Thallium
Zn = Zinc

Attachment I "STANDARD CLAUSES" is included herein by reference.

APPROVED: John J. Conigli

ENVIRODYNE
ENGINEERS

12161 Lackland Road,
St. Louis, Missouri 63146
(314) 434-6960

REPORT OF ANALYSIS

CLIENT: BURNS AND McDONNELL
P.O. Box 173
Kansas City, Missouri 64141
ATTN: Ms. Mary Erio

PROJ. #: 3060-00377
P.O. #:

REPORT DATE: August 22,1986
SAMPLE ANALYZED: Lab Blank data from acid extractable organics reruns.

DATE RECEIVED: N/A
METHODS USED: N/A

ACID COMPOUNDS	DETECTION LIMITS (ug/l)	LAB BLANK (ug/l)	LAB BLANK (ug/l)
2-CHLOROPHENOL	10	ND	ND
2,4-DICHLOROPHENOL	10	ND	ND
2,4-DIMETHYLPHENOL	10	ND	ND
4,6-DINITRO-o-CRESOL	20	ND	ND
2,4-DINITROPHENOL	50	ND	ND
2-NITROPHENOL	20	ND	ND
4-NITROPHENOL	50	ND	ND
p-CHLORO-m-CRESOL	10	ND	ND
PENTACHLOROPHENOL	10	ND	ND
PHENOL	10	ND	ND
2,4,6-TRICHLOROPHENOL	10	ND	ND

SURROGATE COMPOUNDS	PERCENT RECVRY	PERCENT RECVRY
2-F-PHENOL	32	41
PHENOL-D6	26	33
2,4,6-TRIBROMOPHENOL	25	30

The lab blank data from the orininal acid/base-neutral analyses can be found on pages 14, 15, and 16 of our July 8,1986 report to you.

APPROVED: John J. Carighi

ATTACHMENT I - STANDARD CLAUSES

ENVIRODYNE ENGINEERS, INC.

CLIENT: BURNS AND McDONNELL REPORT DATE: JULY 8,1986

The testing services provided herein have been performed, findings obtained, and reports prepared in accordance with generally accepted testing laboratory principles and practices. This warrenty is in lieu of all other warrenties, either expressed or implied.

These tests were conducted in accordance with the standards and procedures specified. Interpretations of the results should take into account that there is a generally recognized and accepted degree of error associated with these and all laboratory analytical tests.

These analyses have been made (tests performed) and report prepared based upon the specific sample(s) provided to us by the client or his/her representative for testing. We assume no responsiblity for variations in quality, composition, appearance, performance, etc. or any other feature of similar subject matter produced, manufactured, fabricated, etc. by persons or under conditions over which we have no control.

Samples will not be held by the laboratory for more than 60 days after the date of receipt. Any extension of this time must be evidenced by written agreement between the laboratory and the client.

This REPORT OF ANALYSIS is furnished in strict confidence for the exclusive use of the client and his/her representatives, and no distribution of all or part of the report shall be made to third parties without the prior written approval of Envirodyne Engineers, Inc. (EEI).

GROSS ALPHA AND BETA

MAY, 1986

Oak Ridge Associated Universities
Post Office Box 117
Oak Ridge, Tennessee 37831-0117

Manpower Education, Research, and Training Division

May 27, 1986

WEST LAKE COMPANIES
RECEIVED
JUN 03 1986
PRESIDENT

Dr. Germain LaRoche
Uranium Fuel Licensing Branch
Division of Fuel Cycle and Material Safety
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: GROSS ALPHA AND GROSS BETA RESULTS - WEST LAKE LANDFILL WELLS

Dear Dr. LaRoche:

Enclosed are the results of our gross alpha and gross beta analyses, performed on 32 well water samples, collected May 7 and 8 at the West Lake Landfill site near St. Charles, Missouri. As can be noted, many of the samples exceed the 5 pCi/l gross alpha level requiring isotopic analyses. Therefore, analyses for Ra-226, Ra-228, isotopic uranium, and isotopic thorium have been initiated; results of these analyses will be available in about 3 weeks.

If you have any questions, please contact me at FTS 626-3305.

Sincerely,

James D. Berger

James D. Berger
Program Manager
Radiological Site Assessment Program

JDB/clt

cc: W. Crow - NMSS
S. Banerji - University of Missouri (Columbia)

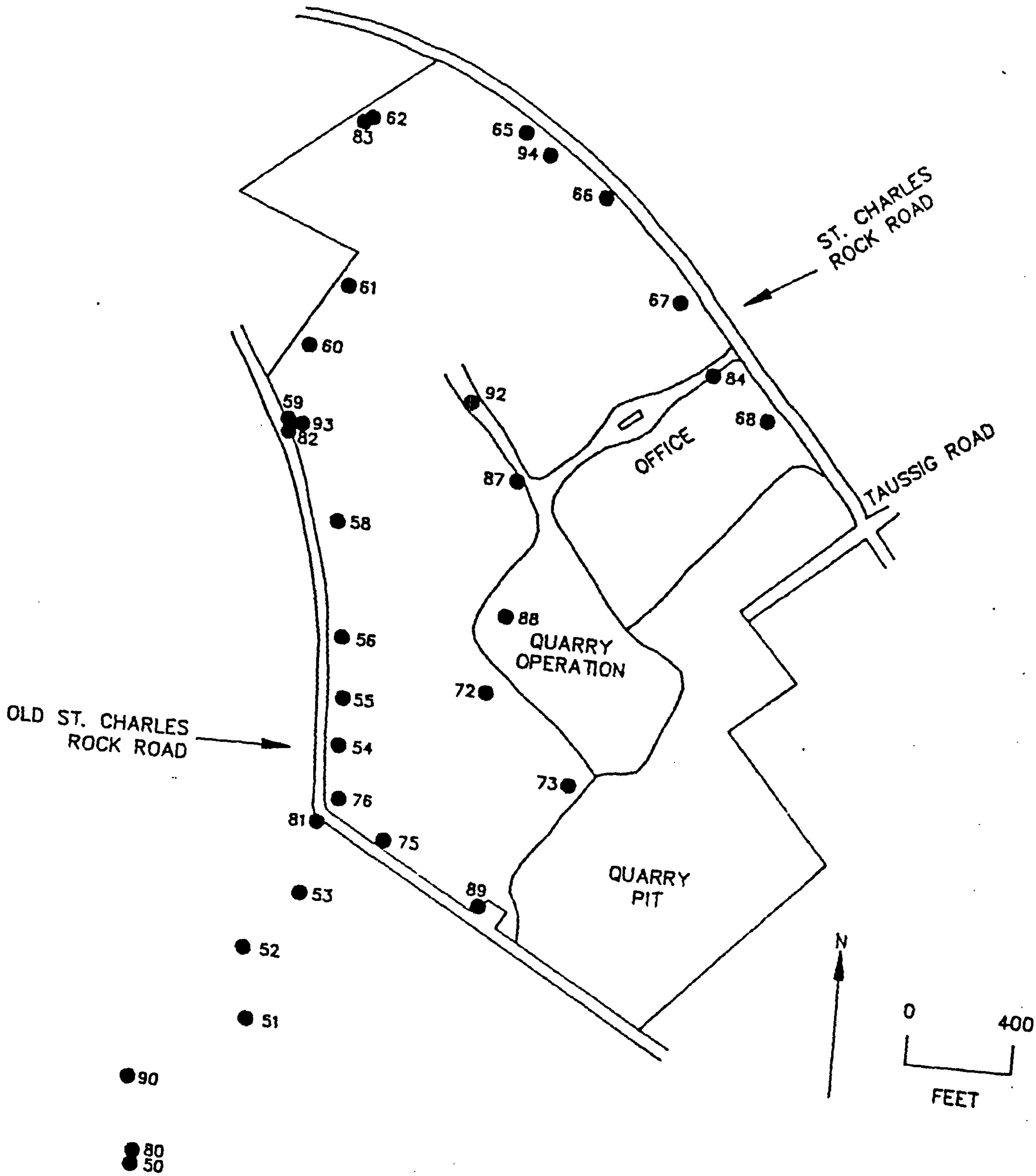
Enclosures

GROSS ALPHA AND GROSS BETA CONCENTRATIONS
IN WELL WATER SAMPLES: MAY 7-8, 1986
WEST LAKE LANDFILL
ST. LOUIS, MISSOURI

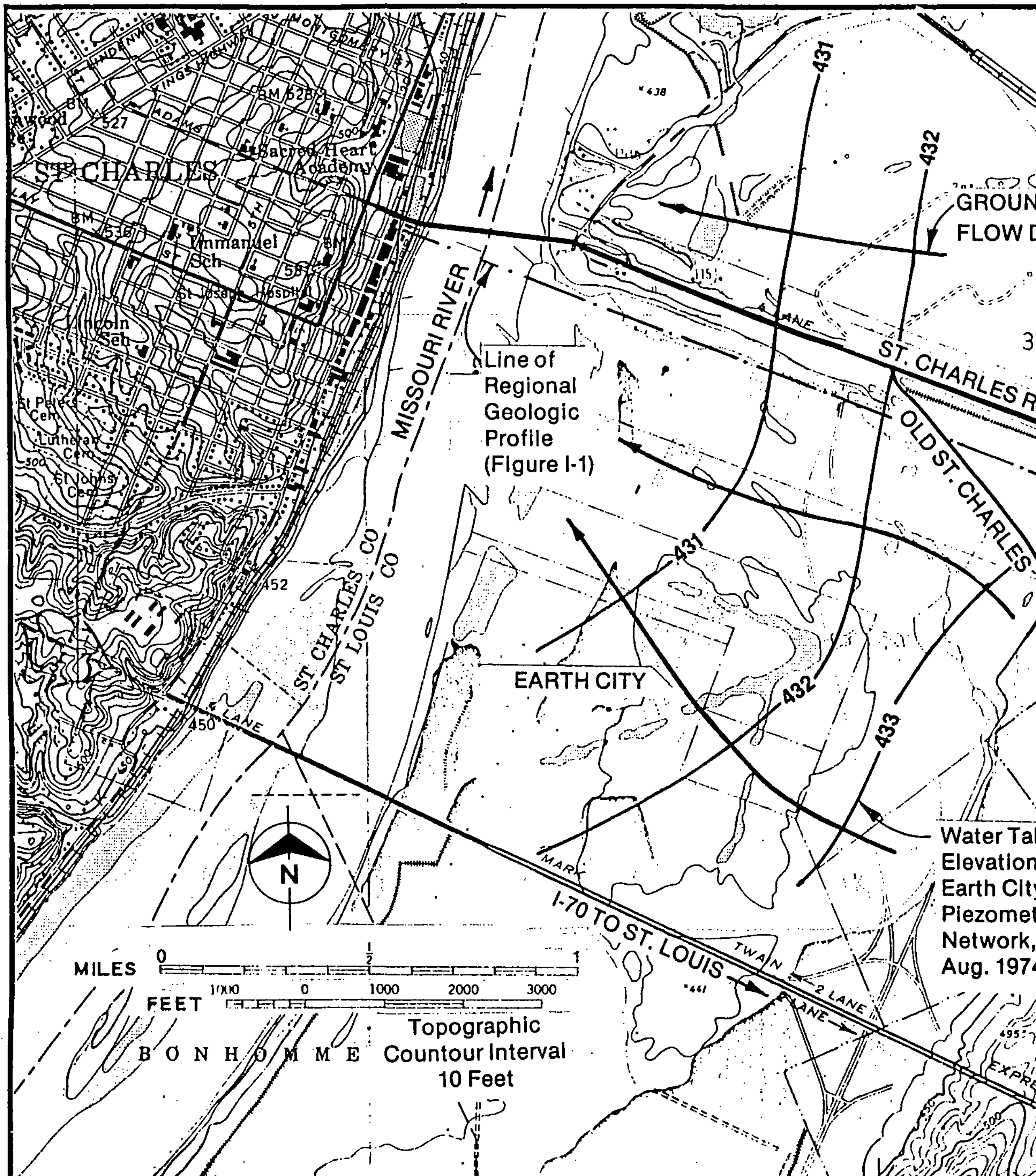
Well[a] Identification	Date Sampled	Depth To Water[b] (m)	Radioactivity Concentrations (pCi/l) Gross Alpha	Gross Beta
50	5/8	5.0	2.23 ± 1.07[c]	7.45 ± 1.36
51	5/7	3.8	2.24 ± 1.12	4.37 ± 1.30
52	5/7	3.2	1.88 ± 0.83	7.51 ± 1.16
53	5/7	3.3	10.6 ± 1.8	15.5 ± 1.7
54	5/7	15.5	4.35 ± 2.08	14.4 ± 3.1
55	5/7	11.5	4.84 ± 1.42	13.9 ± 1.7
56	5/7	12.8	5.69 ± 1.41	11.9 ± 1.6
58	5/7	14.0	5.76 ± 1.34	14.6 ± 1.6
59	5/7	d	11.3 ± 3.3	45.7 ± 4.4
60	5/7	3.5	14.3 ± 1.9	19.0 ± 1.9
61	5/7	4.5	3.33 ± 0.94	14.0 ± 1.4
62	5/7	4.2	5.55 ± 1.26	10.1 ± 1.3
65	5/7	1.9	3.53 ± 1.17	7.39 ± 1.40
66	5/7	1.9	1.75 ± 0.96	9.94 ± 1.38
67	5/7	1.5	8.42 ± 1.69	7.10 ± 1.55
68	5/7	4.4	0.90 ± 1.65	1.91 ± 2.83
72	5/8	10.0	1.39 ± 1.23	4.60 ± 1.65
73	5/8	8.4	6.50 ± 1.53	7.72 ± 1.57
75	5/7	7.6	10.5 ± 2.9	22.3 ± 3.5
76	5/8	13.8	3.60 ± 1.28	6.89 ± 1.77
80	5/8	5.3	8.28 ± 2.19	13.3 ± 2.5
81	5/7	4.8	7.91 ± 1.77	15.6 ± 1.9
82	5/7	5.1	17.0 ± 5.5	46.8 ± 6.6
83	5/7	3.9	8.99 ± 1.77	17.8 ± 2.1
84	5/8	7.0	13.1 ± 4.2	27.3 ± 4.7
87	5/8	9.4	1.47 ± 1.44	7.22 ± 2.36
88	5/8	8.6	10.7 ± 2.5	17.7 ± 2.7
89	5/8	7.5	3.73 ± 1.27	9.10 ± 1.55
90	5/7	4.1	2.23 ± 0.92	6.81 ± 1.52
92	5/8	13.1	7.25 ± 1.88	11.3 ± 2.5
93	5/7	4.7	7.42 ± 1.99	21.7 ± 2.9
94	5/7	2.1	1.62 ± 0.89	

[a]Refer to attached Figure.
[b]As measured below ground surface.
[c]Errors are 2σ based only on counting statistics.
[d]Depth not determined.

WLL1



Well Sampling Locations at West Lake Landfill
May 7 and 8, 1986



Barns & McDonnell

Figure IN-1
SITE LOCATION
AND REGIONAL
GROUNDWATER MAP

RESULT SUMMARY SHEETS

PESTICIDES AND PCBs

Environmental Trace Substances Research Center

Volatile Result Summary

Sample Source: Burns & McDonnell

Submitter ID#: D-88

ETSRC ID#: 85120506 Data File#: VOL506

Sample Matrix: Water

Method: U.S.E.P.A. #624

Date Received. December 17, 1985

Date Analyzed: Conc. Units mcg/L

Analyst: C. Orazio

Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1. Methylene chloride	84	209	5464	5.2	6.1
2 1,1 Dichloroethylene	96				<MDL
3. 1,1 Dichloroethane	63				<MDL
4. 1,2 Dichloroethylene	96				<MDL
5. Chloroform	83				<MDL
6. 1,2, Dichloroethane	62				<MDL
7. 1,1,1 Trichloroethane	97				<MDL
8. Carbon tetrachloride	117				<MDL
9. Bromodichloromethane	127				<MDL
10. 1,2 Dichloropropane	65				<MDL
11. 1 3 Dichloropropylene	75				<MDL
12. Trichloroethylene	130				<MDL
13. Benzene	78				<MDL
14. cis 1,3 Dichloropropylene	75				<MDL
15. 1,1,2 Trichloroethane	97				<MDL
16. Dibromochloromethane	127				<MDL
17. 2 Chloroethylvinyl ether	63				<MDL
18. Bromoform	173				<MDL
19. Tetrachloroethylene	164				<MDL
20. 1,1,2,2 Tetrachloroethane	83				<MDL
21. Toluene	92				<MDL
22. Chlorobenzene	112				<MDL
23. Ethylbenzene	91				<MDL

Surrogate Results

Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1. Benzene D-8	84	528	69364	30.6	
2. Toluene D-8	100	715	31487	31.9	
3. p-Bromofluorobenzene	95	905	22001	35.2	

Tentatively Identified Compounds

Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1. Acetone	58	227		-NQ-	

Environmental Trace Substances Research Center

Volatile Result Summary

Detection Limits

Sample Source: Burns & McDonnell
Submitter ID#:
ETSRC ID#: Data File#:
Sample Matrix: Water
Method: U.S.E.P.A. #624
Date Received: December 17, 1985
Date Analyzed: Conc. Units: mcg/L
Analyst: C. Orazio

Compound	Qantity m/e	Scan #	Area	Conc	Corr Conc
1. Methylene chloride	84				2.5
2. 1,1 Dichloroethylene	96				2.5
3. 1,1 Dichloroethane	63				4.0
4. 1,2 Dichloroethylene	96				1.5
5. Chloroform	83				2.5
6. 1,2, Dichloroethane	62				2.5
7. 1,1,1 Trichloroethane	97				3.0
8. Carbon tetrachloride	117				2.5
9. Bromodichloromethane	127				2.0
10. 1,2 Dichloropropane	65				5.0
11. 1,3 Dichloropropylene	75				4.0
12. Trichloroethylene	130				1.5
13. Benzene	78				4.0
14. cis 1,3 Dichloropropylene	75				2.5
15. 1,1,2 Trichloroethane	97				4.0
16. Dibromochloromethane	127				2.5
17. 2 Chloroethylvinyl ether	63				5.0
18. Bromoform	173				4.0
19. Tetrachloroethylene	164				3.0
20. 1,1,2,2 Tetrachloroethane	83				5.5
21. Toluene	92				5.0
22. Chlorobenzene	112				5.0
23. Ethylbenzene	91				6.0

Environmental Trace Substances Research Center
Volatile Result Summary

Sample Source: Burns & McDonnell
Submitter ID#: D-81
ETSRC ID#: 85120501 Data File#: VOL 501B
Sample Matrix: Water
Method: U.S.E.P.A. #624
Date Received: December 17, 1985
Date Analyzed: Conc. Units: mcg/L
Analyst: C. Orazio

Compound	Quantity m/e	Scan #	Area	Conc.	Corr Conc
1. Methylene chloride	84	209	27740	26.3	23.3
2 1,1 Dichloroethylene	96				<MDL
3. 1,1 Dichloroethane	63				<MDL
4. 1,2 Dichloroethylene	96				<MDL
5. Chloroform	83				<MDL
6. 1,2, Dichloroethane	62				<MDL
7. 1,1,1 Trichloroethane	97				<MDL
8. Carbon tetrachloride	117				<MDL
9. Bromodichloromethane	127				<MDL
10. 1,2 Dichloropropane	65				<MDL
11. 1,3 Dichloropropylene	75				<MDL
12. Trichloroethylene	130				<MDL
13. Benzene	78				<MDL
14. cis 1,3 Dichloropropylene	75				<MDL
15. 1,1,2 Trichloroethane	97				<MDL
16. Dibromochloromethane	127				<MDL
17. 2 Chloroethylvinyl ether	63				<MDL
18. Bromoform	173				<MDL
19. Tetrachloroethylene	164				<MDL
20. 1,1,2,2 Tetrachloroethane	83				<MDL
21. Toluene	92				<MDL
22. Chlorobenzene	112				<MDL
23. Ethylbenzene	91				<MDL

Result Summary Sheet

Submitter ID: Burns and McDonnel # D-94 OR

ETSRC ID: 5120528 R. Data File: A5120528

Sample Matrix: Water

Analytes: Priority pollutant phenols

Method: EPA604 - GC/MS

Date Recieved/Analyzed: Dec. 1986/Jan. 1, 1986

Analyst: Carl Orazio

Conc Units mcg/L

Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1. Phenol					<MDL
2. 2-Chlorophenol					<MDL
3. 2-Nitrophenol					<MDL
4. 2,4-Dimethylphenol					<MDL
5. 2,4-Dichlorophenol					<MDL
6. 4-Chloro, 3-Methylphenol					<MDL
7. 2,4,6-Trichlorophenol					<MDL
8. 2,4-Dinitrophenol					<MDL
9. 4-Nitrophenol					<MDL
10. 4,6-Dinitro, 2-Methylphenol					<MDL
11. Pentachlorophenol					<MDL
Phenol D-5 (Surrogate) rec					21.2%

Result Summary Sheet

Submitter ID: Burns and McDonnel # D-95 OR

ETSRC ID: 5120529 R. Data File: A5120529

Sample Matrix: Water

Analytes: Priority pollutant phenols

Method: EPA604 - GC/MS

Date Recieved/Analyzed: Dec. 1986/Jan. 1, 1986

Analyst: Carl Orazio

Conc. Units: mcg/L

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1.	Phenol					<MDL
2.	2-Chlorophenol					<MDL
3.	2-Nitrophenol					<MDL
4.	2,4-Dimethylphenol					<MDL
5.	2,4-Dichlorophenol					<MDL
6.	4-Chloro, 3-Methylphenol					<MDL
7.	2,4,6-Trichlorophenol					<MDL
8.	2,4-Dinitrophenol					<MDL
9.	4-Nitrophenol					<MDL
10.	4,6-Dinitro, 2-Methylphenol					<MDL
11.	Pentachlorophenol					<MDL
	Phenol D-5 (Surrogate) rec					36.7%

Result Summary Sheet

Submitter ID: Burns and McDonnel # D-91 CK (DUP.)

ETSRC ID: 5120525d R. Data File: A5120525D

Sample Matrix: Water

Analytes: Priority pollutant phenols

Method: EPA604 - GC/MS

Date Recieved/Analyzed: Dec. 1986/Jan. 1, 1986

Analyst: Carl Orazio

Conc Units: mcg/L

	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1.	Phenol					<MDL
2	2-Chlorophenol					<MDL
3.	2-Nitrophenol					<MDL
4.	2,4-Dimethylphenol					<MDL
5.	2,4-Dichlorophenol					<MDL
6.	4-Chloro, 3-Methylphenol					<MDL
7.	2,4,6-Trichlorophenol					<MDL
8.	2,4-Dinitrophenol					<MDL
9.	4-Nitrophenol					<MDL
10.	4,6-Dinitro, 2-Methylphenol					<MDL
11.	Pentachlorophenol					<MDL
	Phenol D-5 (Surrogate) rec					20.8%

Result Summary Sheet

Submitter ID: Burns and McDonnel # D-qc OR (Spk)

ETSRC ID: 51205245 R. Data File: 51205245

Sample Matrix: Water

Analytes: Priority pollutant phenols

Method: EPA604 - GC/MS

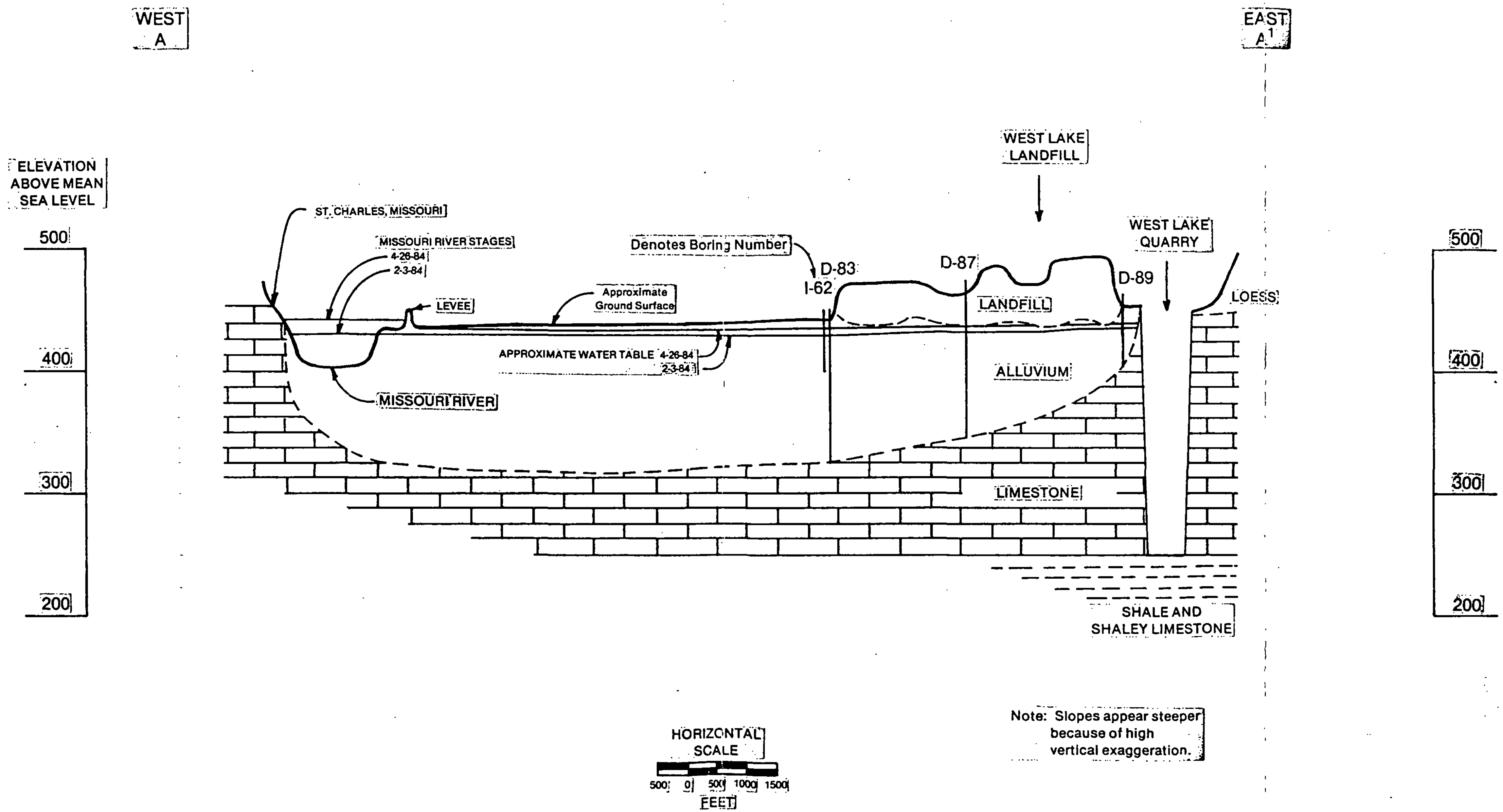
Date Recieved/Analyzed: Dec. 1986/Jan. 1, 1986

Analyst: Carl Orazio

Conc. Units: mcg/L

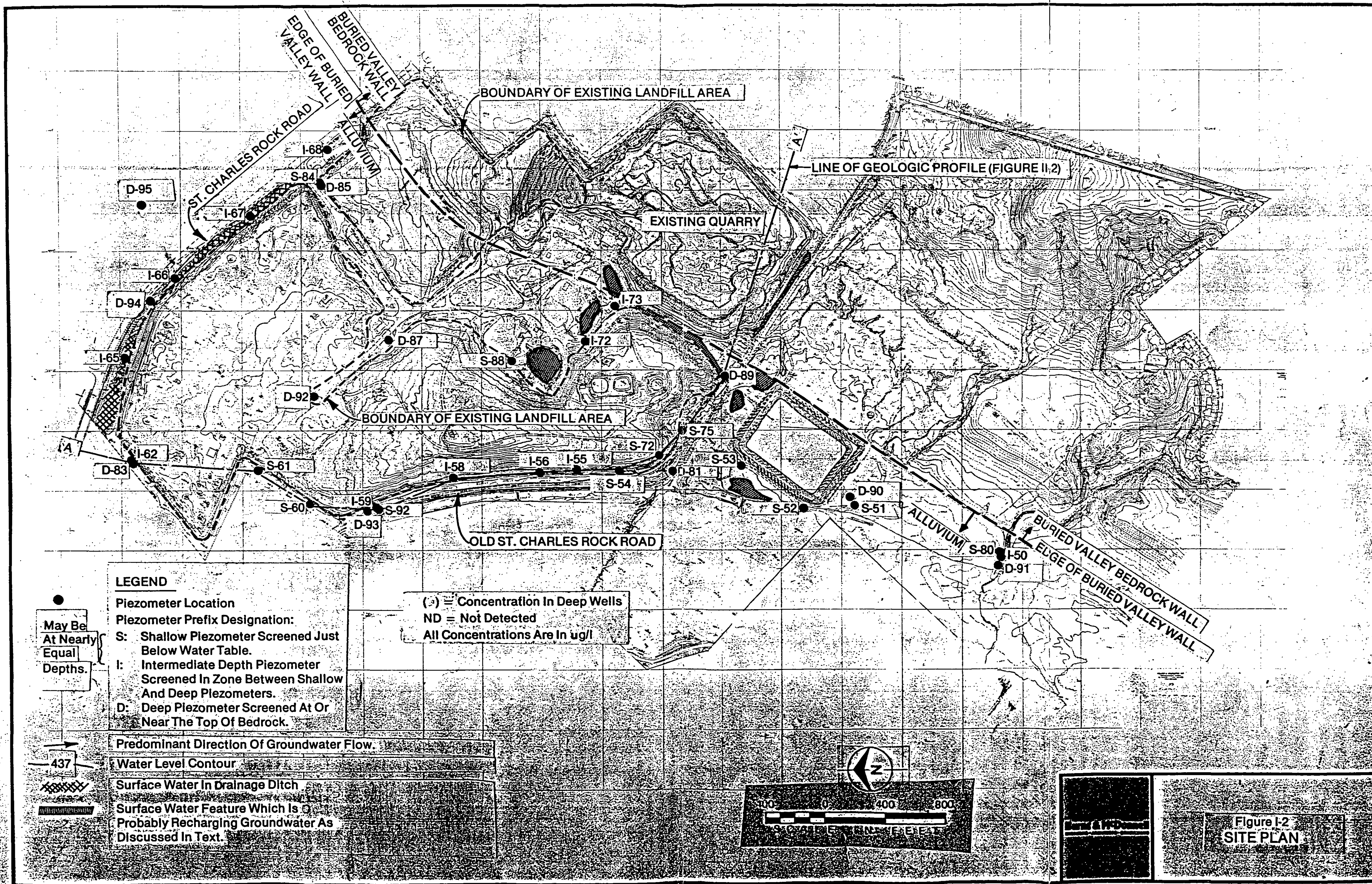
	Compound	Quantity m/e	Scan #	Area	Conc	Corr Conc
1.	Phenol			2593		6.8
2.	2-Chlorophenol					<MDL
3.	2-Nitrophenol			739		4.8
4.	2,4-Dimethylphenol					<MDL
5.	2,4-Dichlorophenol					<MDL
6.	4-Chloro, 3-Methylphenol			678		19.0
7.	2,4,6-Trichlorophenol					<MDL
8.	2,4-Dinitrophenol					<MDL
9.	4-Nitrophenol			475		4.5
10.	4,6-Dinitro, 2-Methylphenol					<MDL
11.	Pentachlorophenol			5708		19.0

Phenol D-5 (Surrogate) rec



Burns & McDonnell

Figure I-1
REGIONAL GEOLOGIC
PROFILE


BURIED VALLEY BEDROCK WALL
EDGE OF BURIED VALLEY WALL
ALLUVIUM
ST. CHARLES ROCK ROAD
BOUNDARY OF EXISTING LANDFILL AREA
A'
LINE OF GEOLOGIC PROFILE (FIGURE II-2)
EXISTING QUARRY
I-68
S-84
D-85
D-95
I-67
I-66
D-94
I-73
D-87
I-72
S-88
I-65
D-89
D-92
BOUNDARY OF EXISTING LANDFILL AREA
S-75
A
I-62
S-72
D-83
S-61
I-58
I-56
I-55
S-53
D-81
S-54
D-90
S-60
I-59
S-92
S-52
S-51
D-93
OLD ST. CHARLES ROCK ROAD
ALLUVIUM
S-80
I-50
D-91
BURIED VALLEY BEDROCK WALL
EDGE OF BURIED VALLEY WALL
LEGEND
Piezometer Location
Piezometer Prefix Designation:
S: Shallow Piezometer Screened Just Below Water Table.
I: Intermediate Depth Piezometer Screened In Zone Between Shallow And Deep Piezometers.
D: Deep Piezometer Screened At Or Near The Top Of Bedrock.
May Be At Nearly Equal Depths.
( ) = Concentration In Deep Wells
ND = Not Detected
All Concentrations Are In ug/l
Predominant Direction Of Groundwater Flow.
437
Water Level Contour
Surface Water In Drainage Ditch
Surface Water Feature Which Is Probably Recharging Groundwater As Discussed In Text.
N
400
800
Figure I-2
SITE PLAN

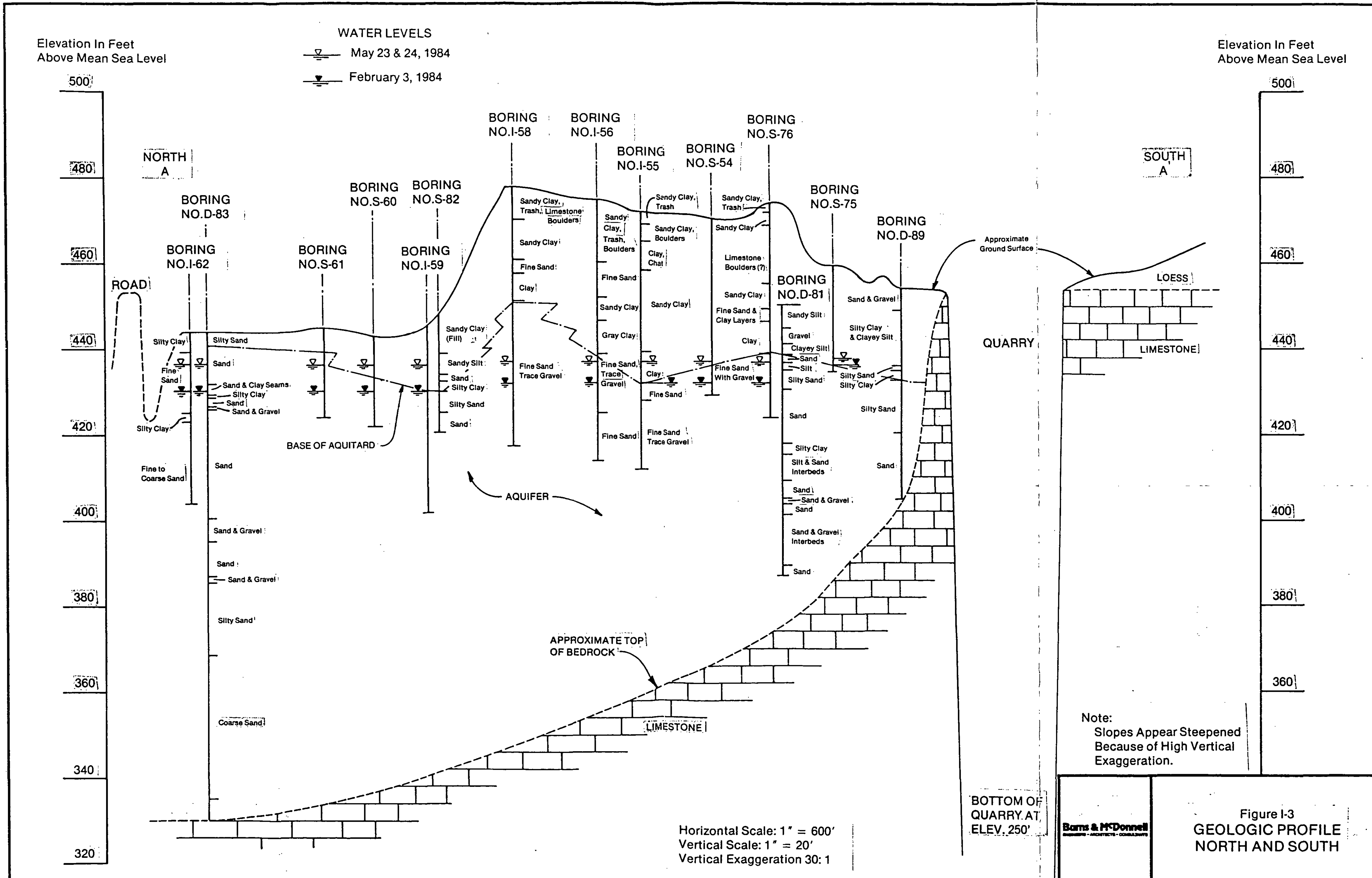


Figure I-3
GEOLOGIC PROFILE
NORTH AND SOUTH

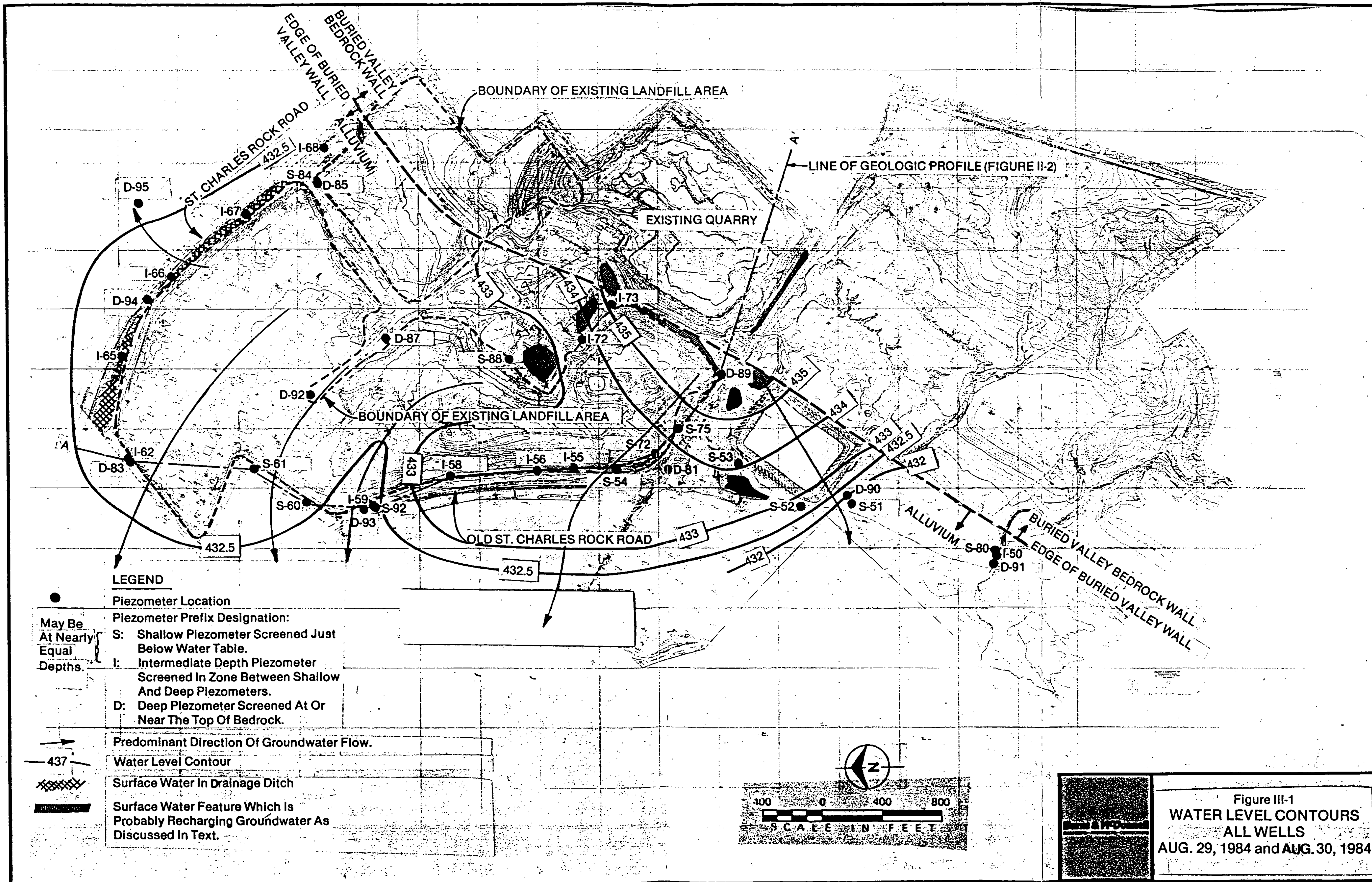
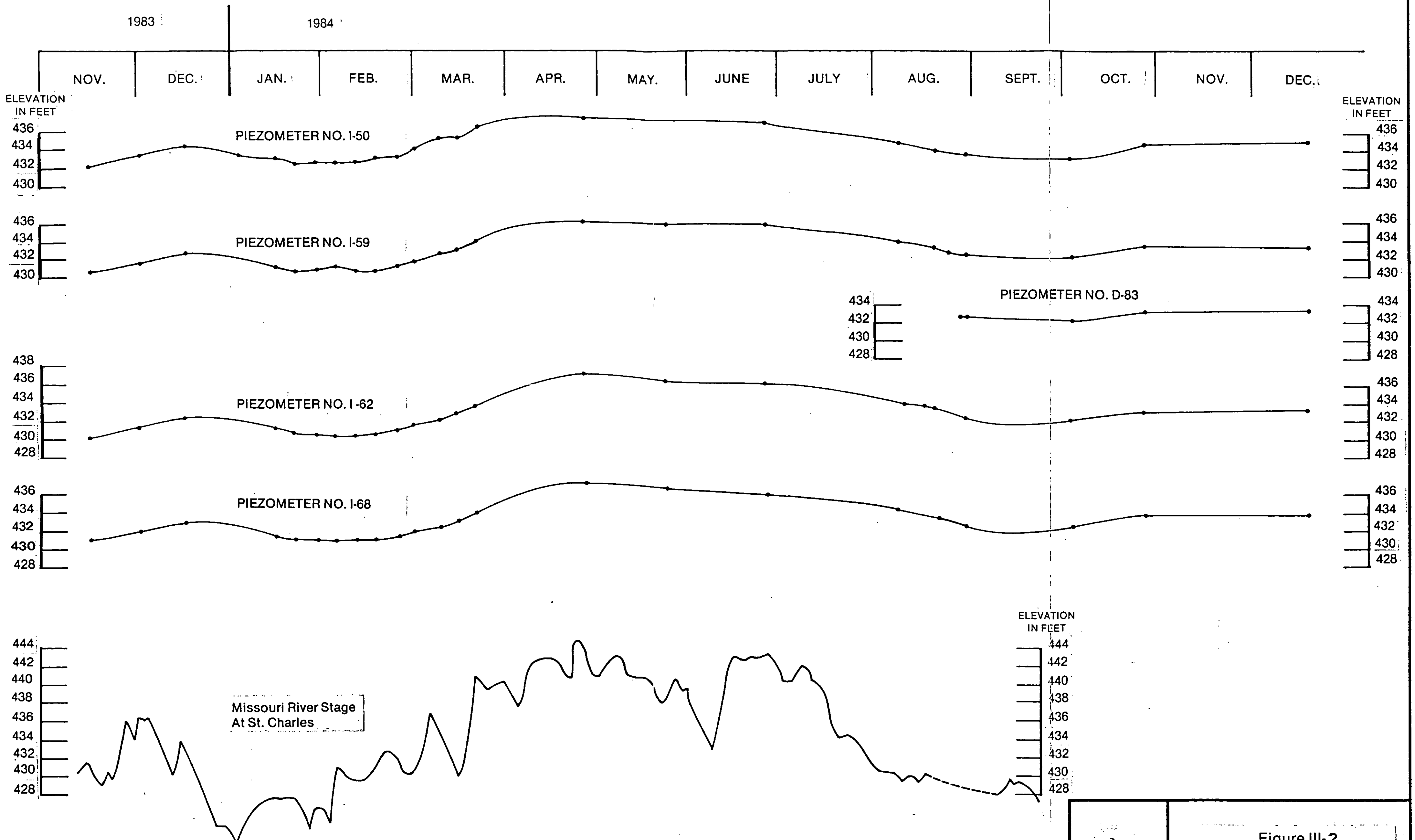


Figure III-1
WATER LEVEL CONTOURS
ALL WELLS
AUG. 29, 1984 and AUG. 30, 1984



Barns & McDonnell

Figure III-2
PIEZOMETER AND RIVER HYDROGRAPHS
NOV. 1983-DEC. 1984

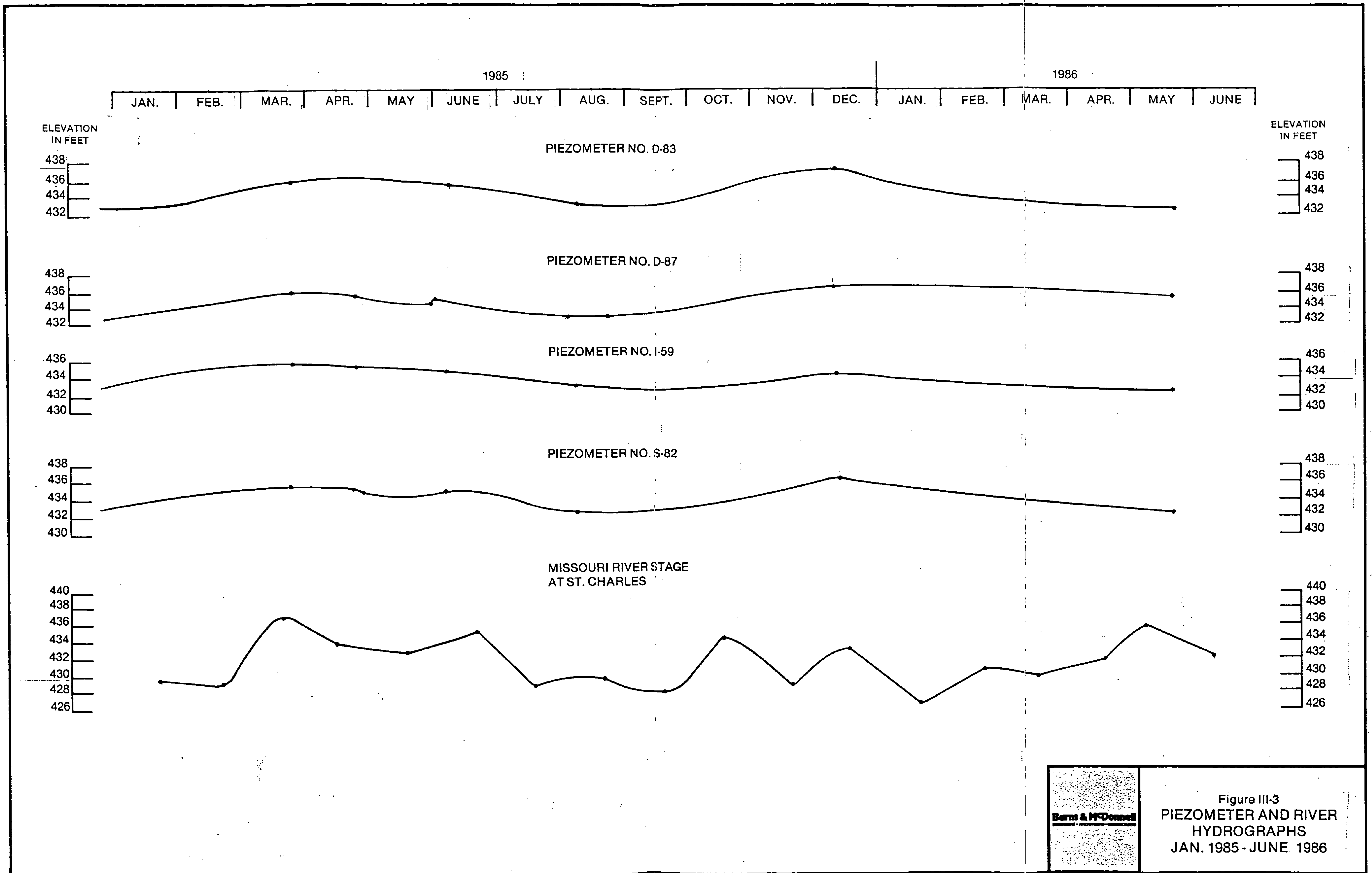


Figure III-3
PIEZOMETER AND RIVER HYDROGRAPHS
JAN. 1985 - JUNE 1986

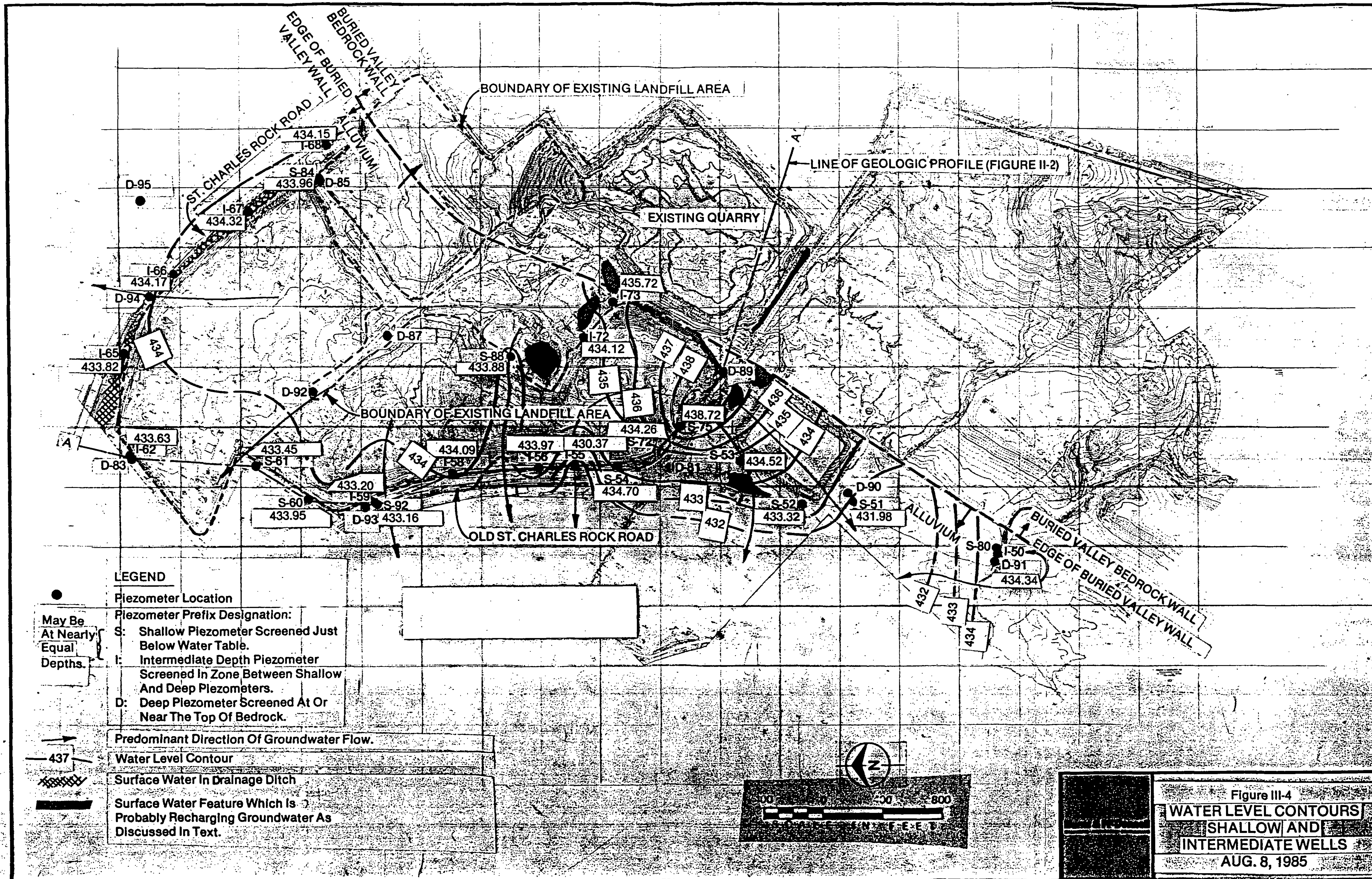


Figure III-4
WATER LEVEL CONTOURS
SHALLOW AND
INTERMEDIATE WELLS
AUG. 8, 1985

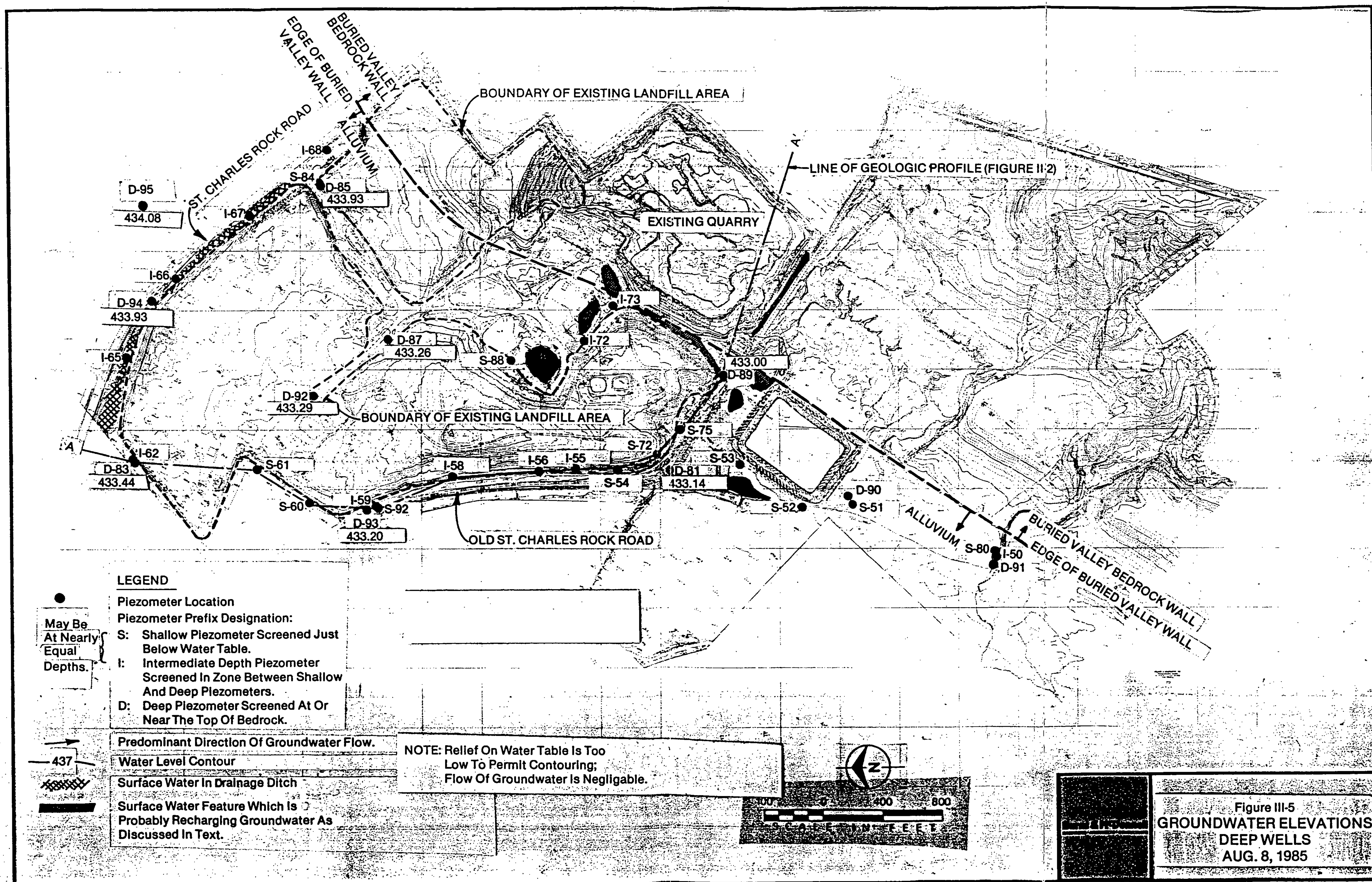


Figure III-5
GROUNDWATER ELEVATIONS
DEEP WELLS
AUG. 8, 1985

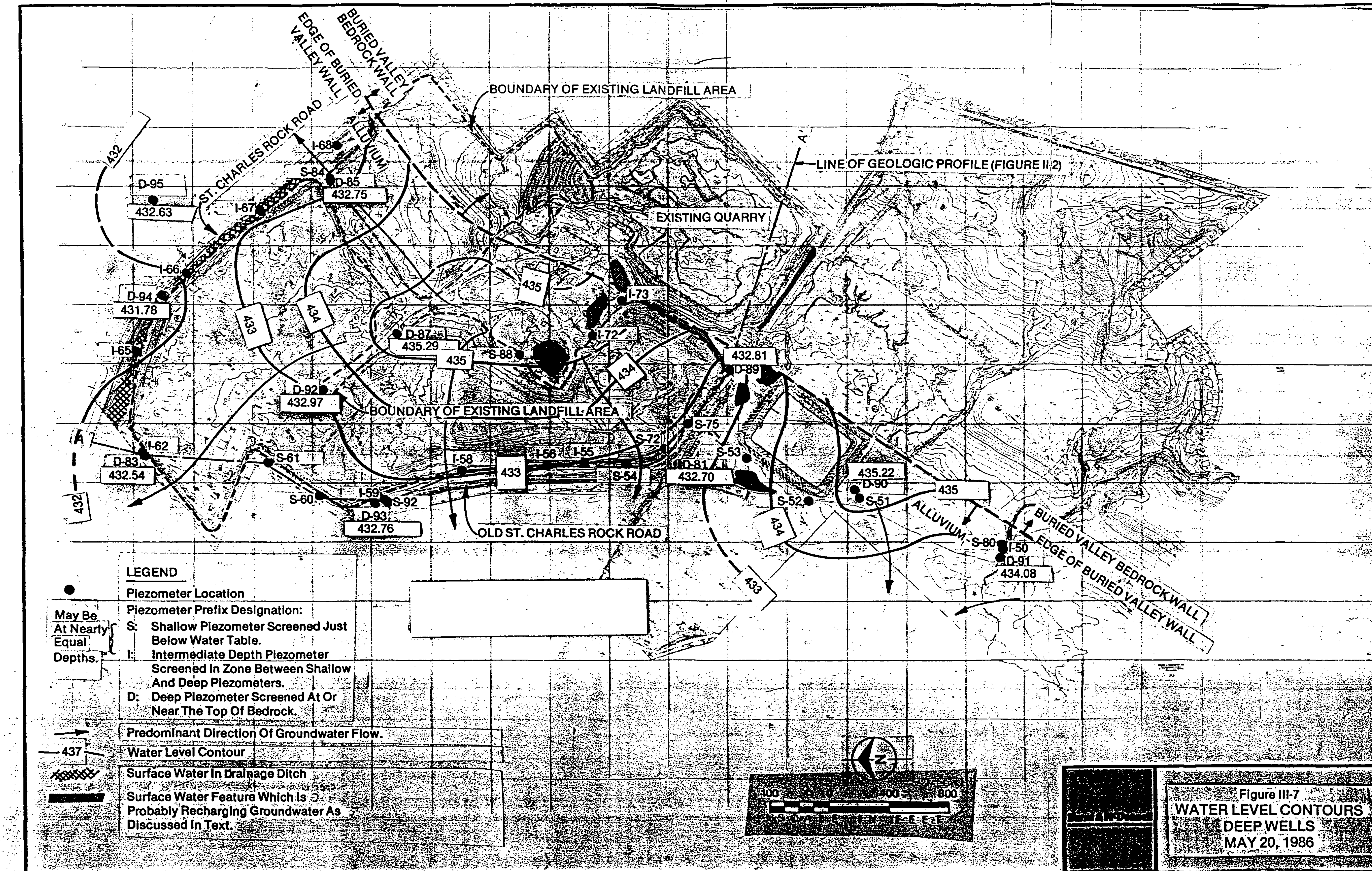


Figure III-7
WATER LEVEL CONTOURS
DEEP WELLS
MAY 20, 1986

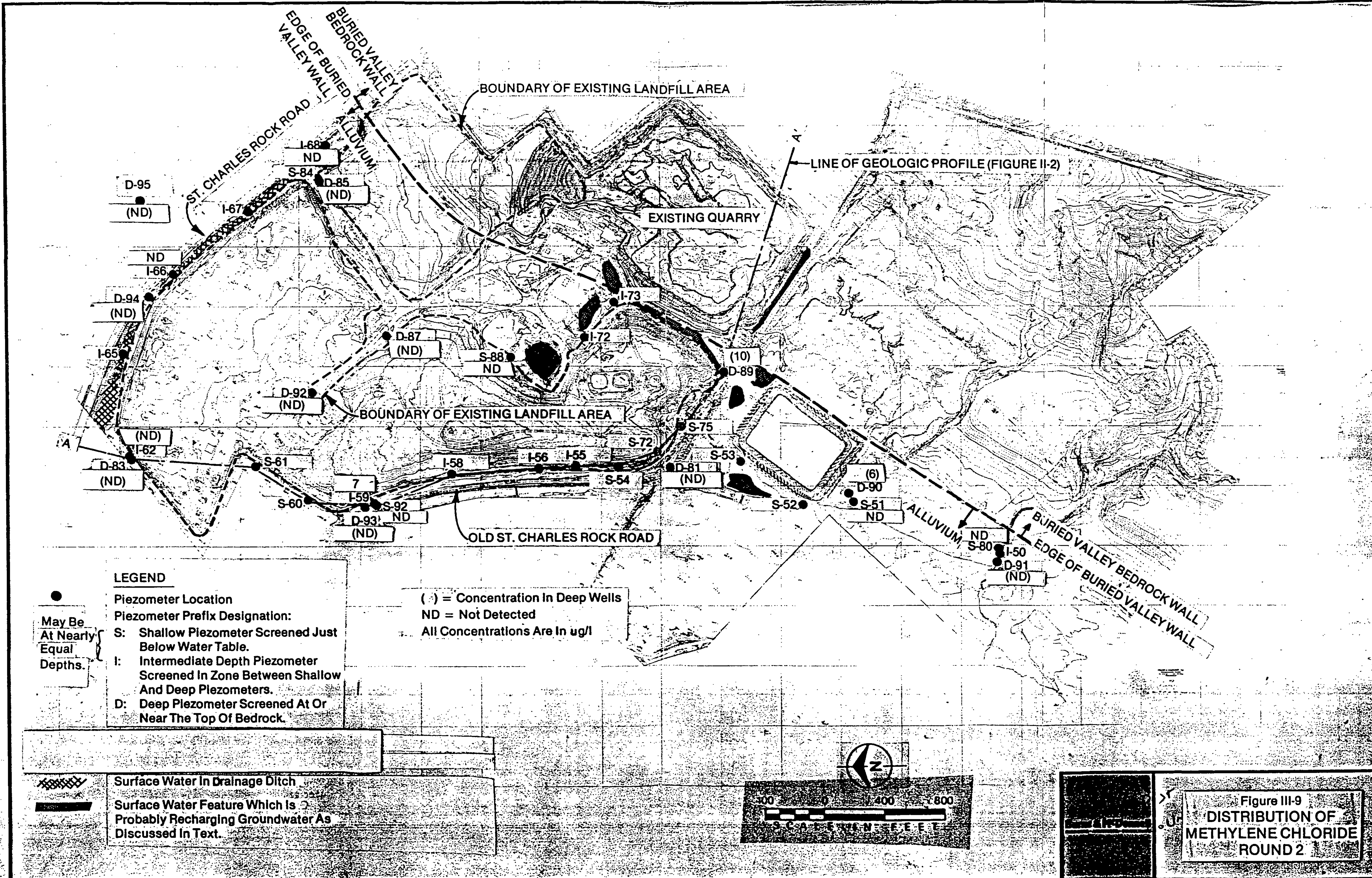


Figure III-9
DISTRIBUTION OF METHYLENE CHLORIDE ROUND 2

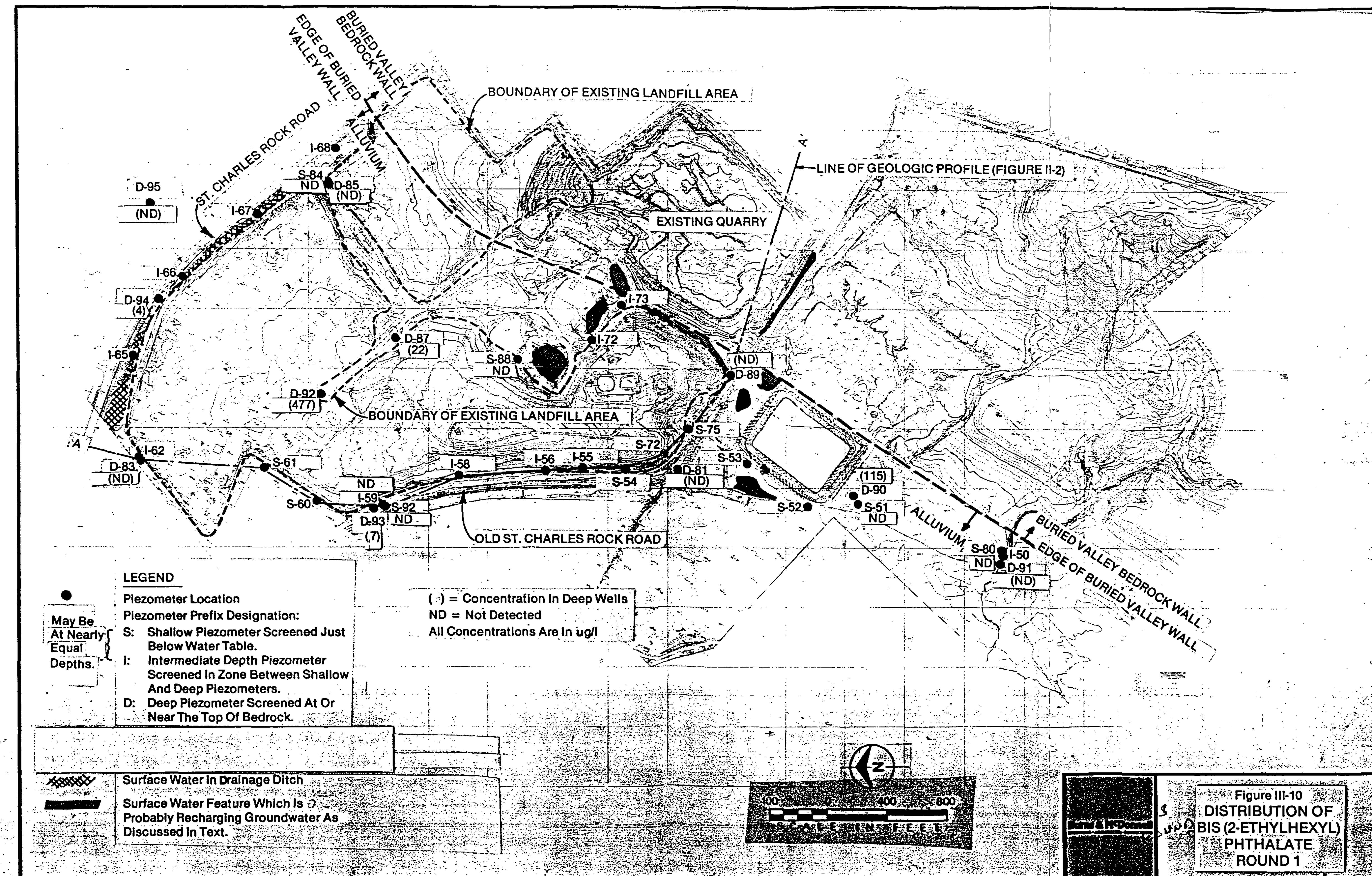


Figure III-10
DISTRIBUTION OF
BIS (2-ETHYLHEXYL)
PHTHALATE
ROUND 1

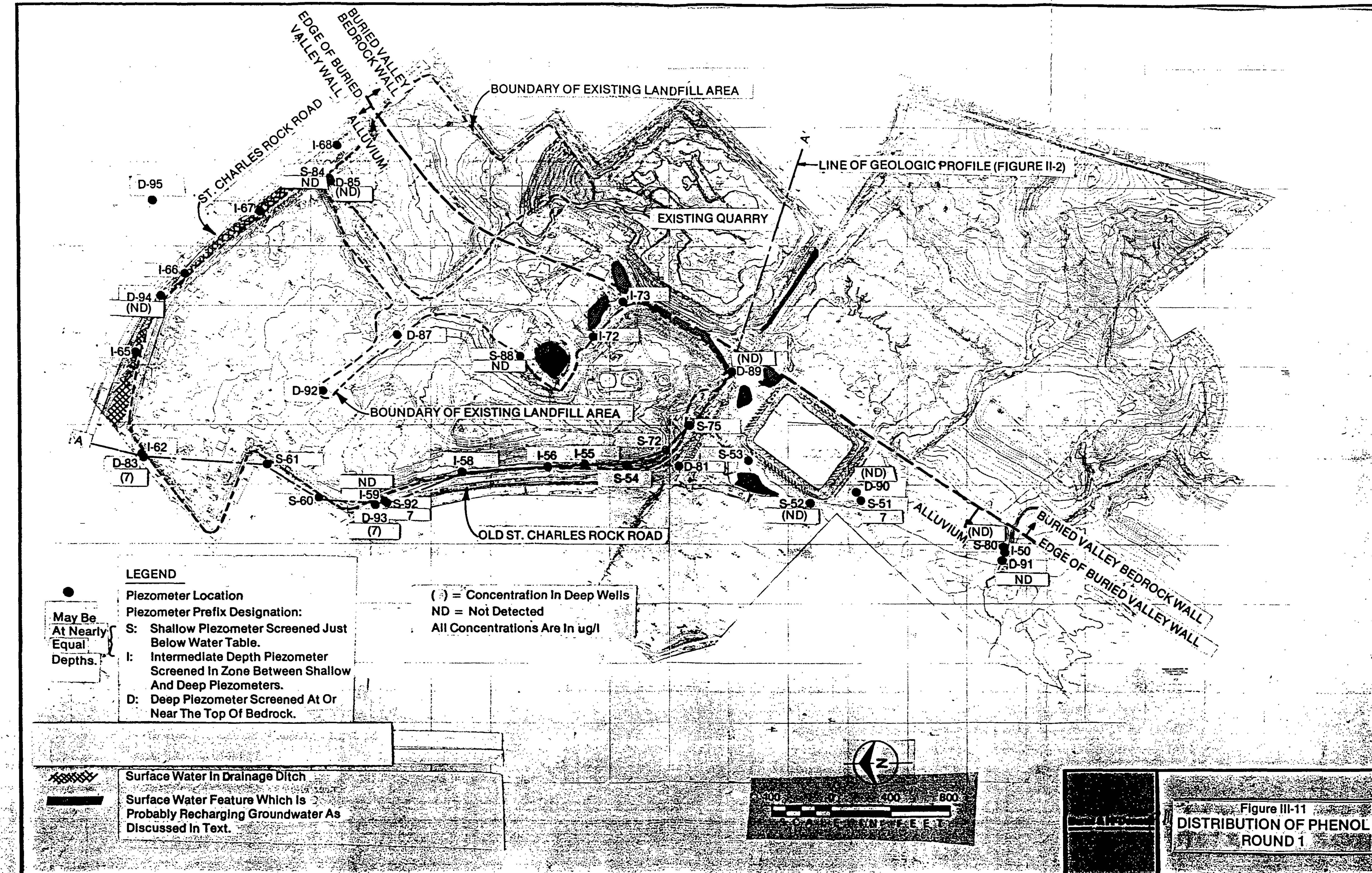


Figure III-11
DISTRIBUTION OF PHENOL
ROUND 1

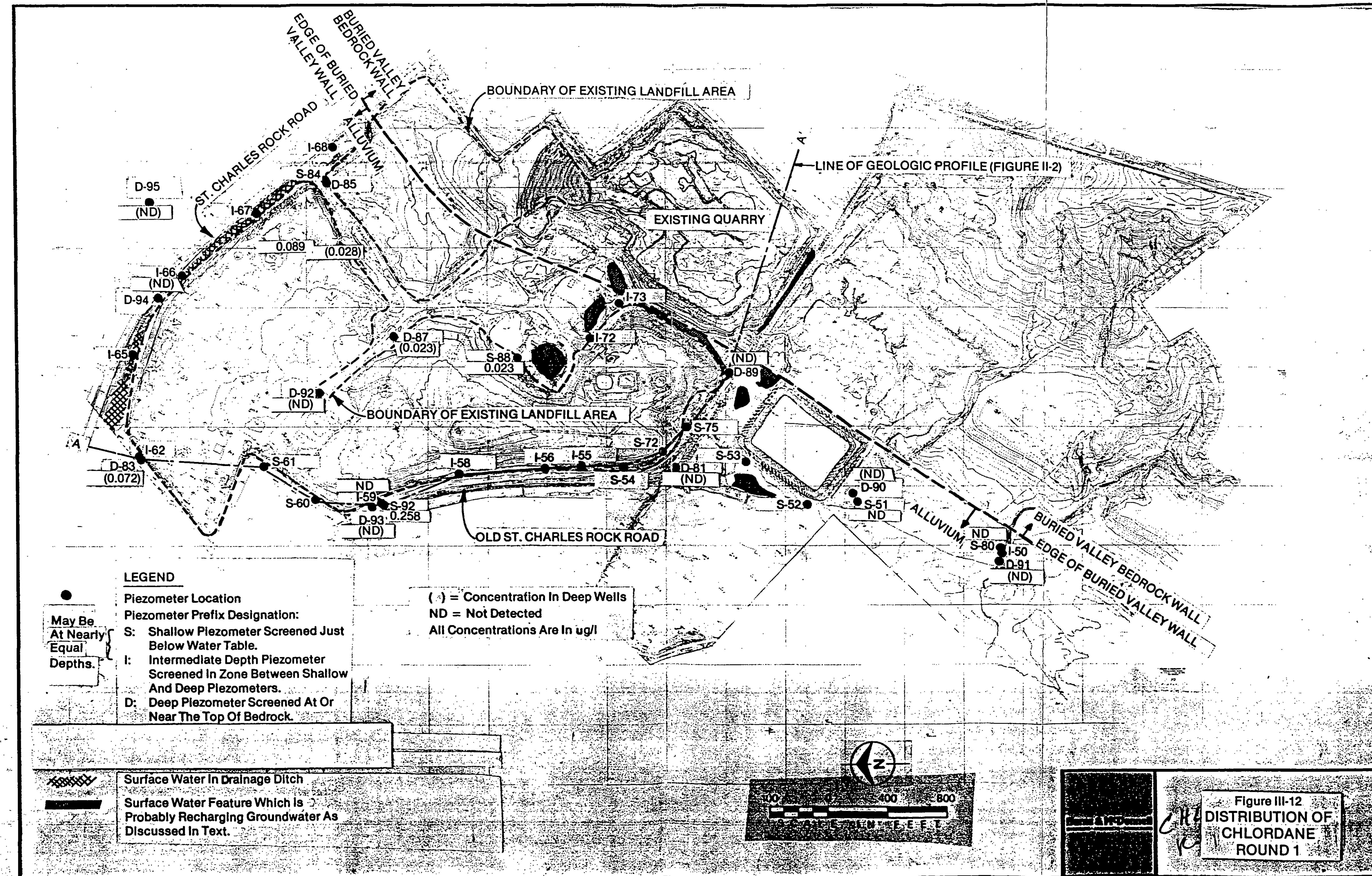


Figure III-12
DISTRIBUTION OF CHLORDANE
ROUND 1

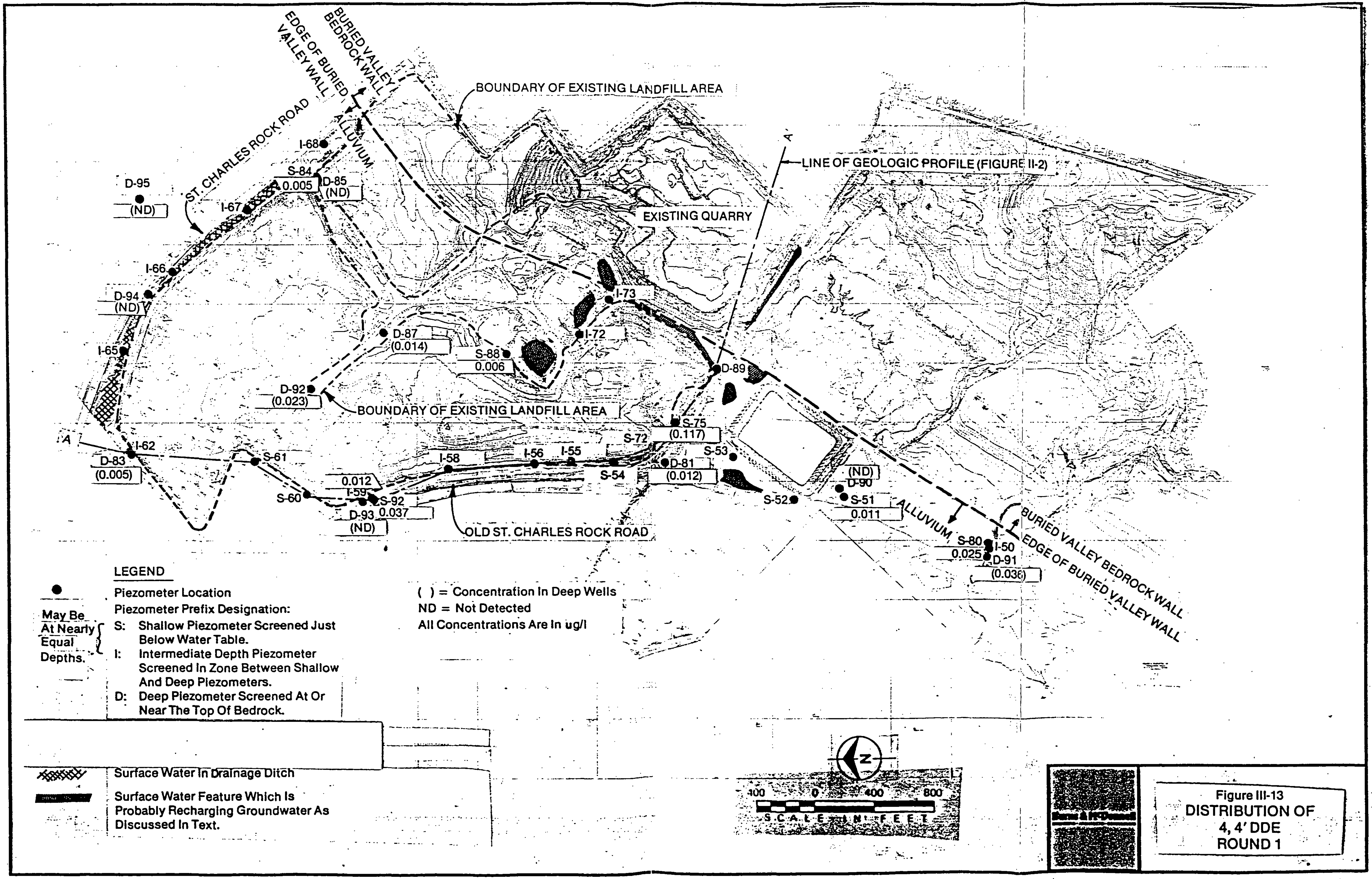


Figure III-13
DISTRIBUTION OF 4, 4' DDE ROUND 1

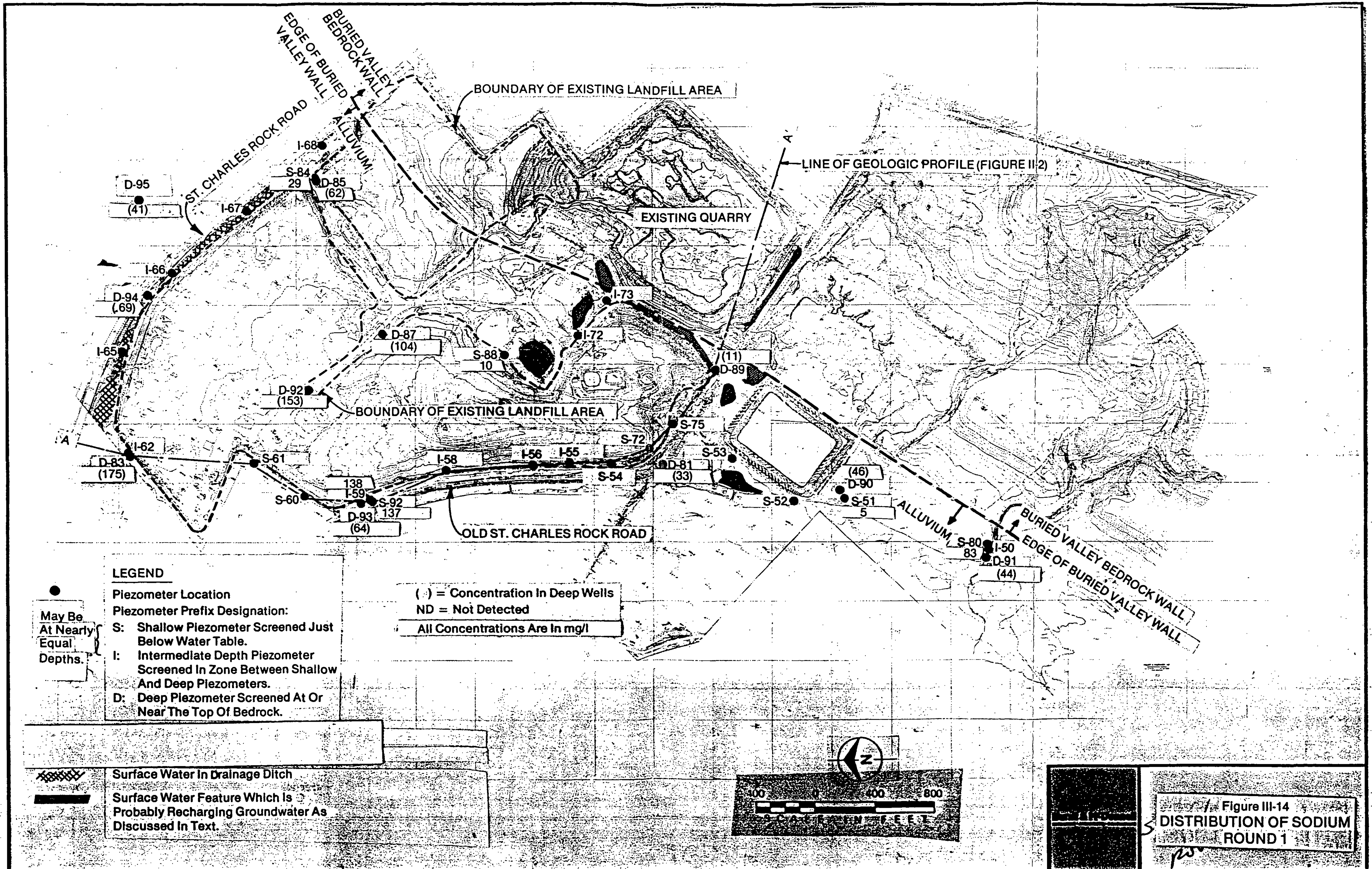


Figure III-14
DISTRIBUTION OF SODIUM
ROUND 1

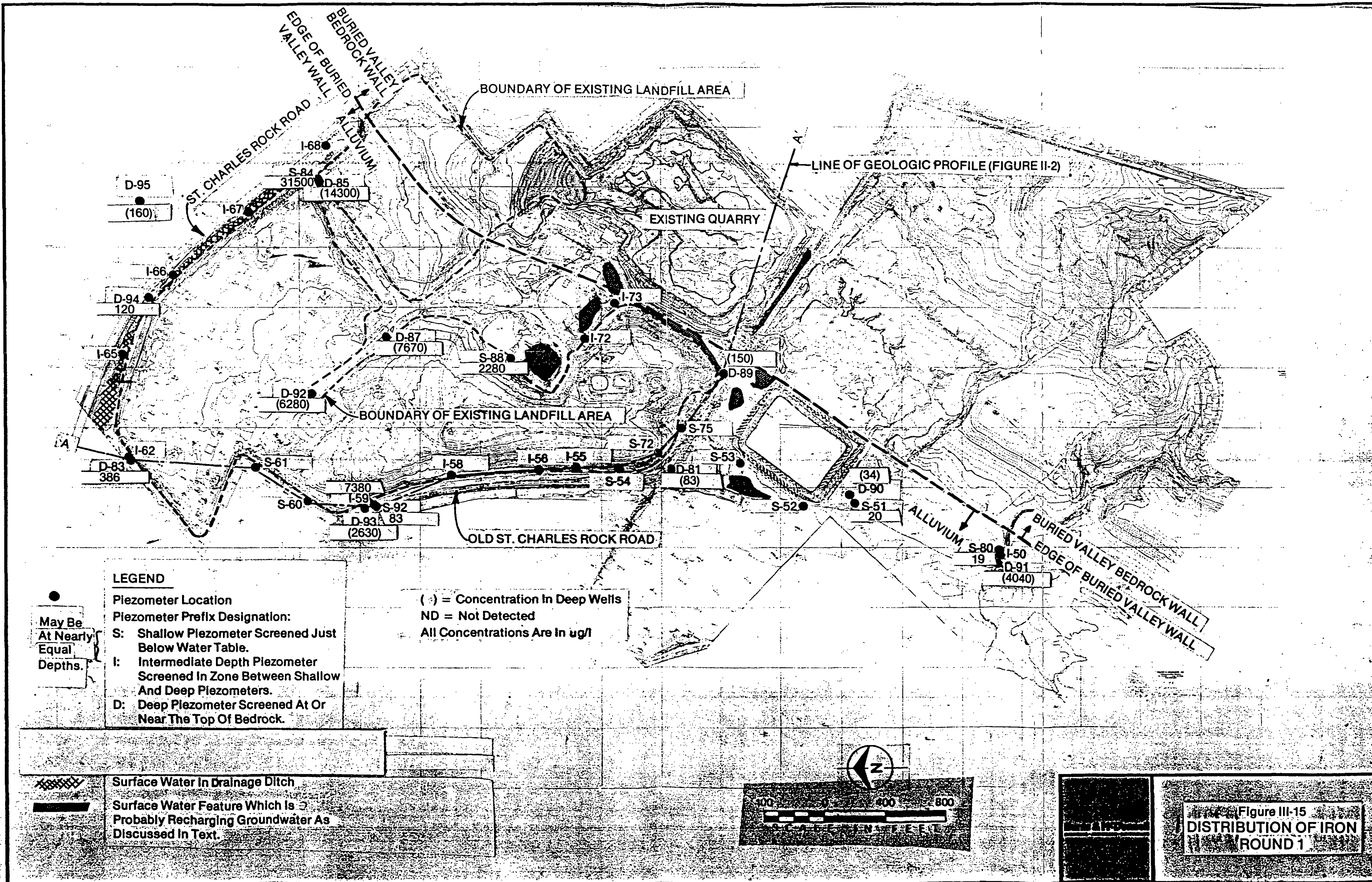


Figure III-15
DISTRIBUTION OF IRON
ROUND 1

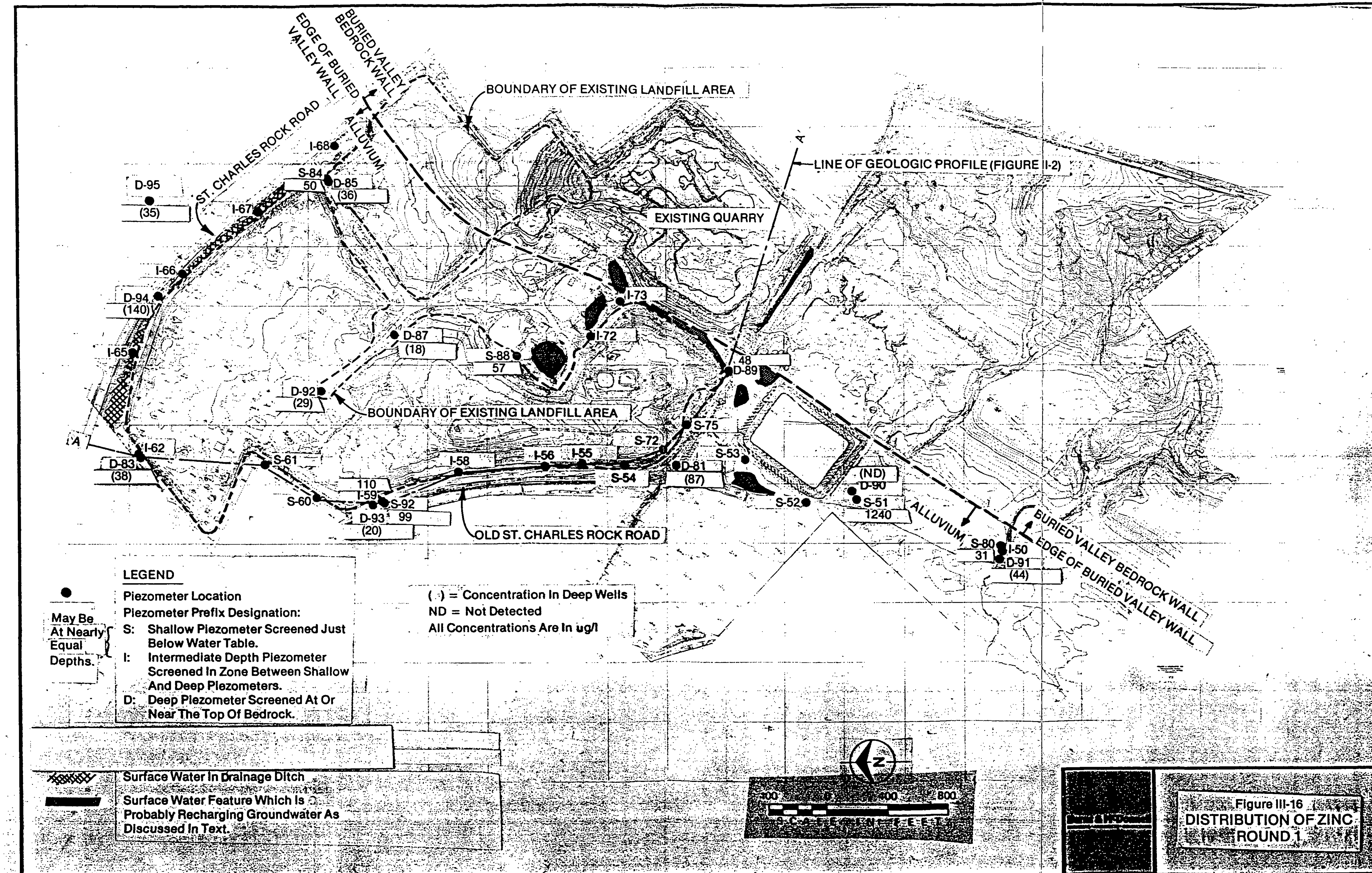


Figure III-16
DISTRIBUTION OF ZINC
ROUND 1

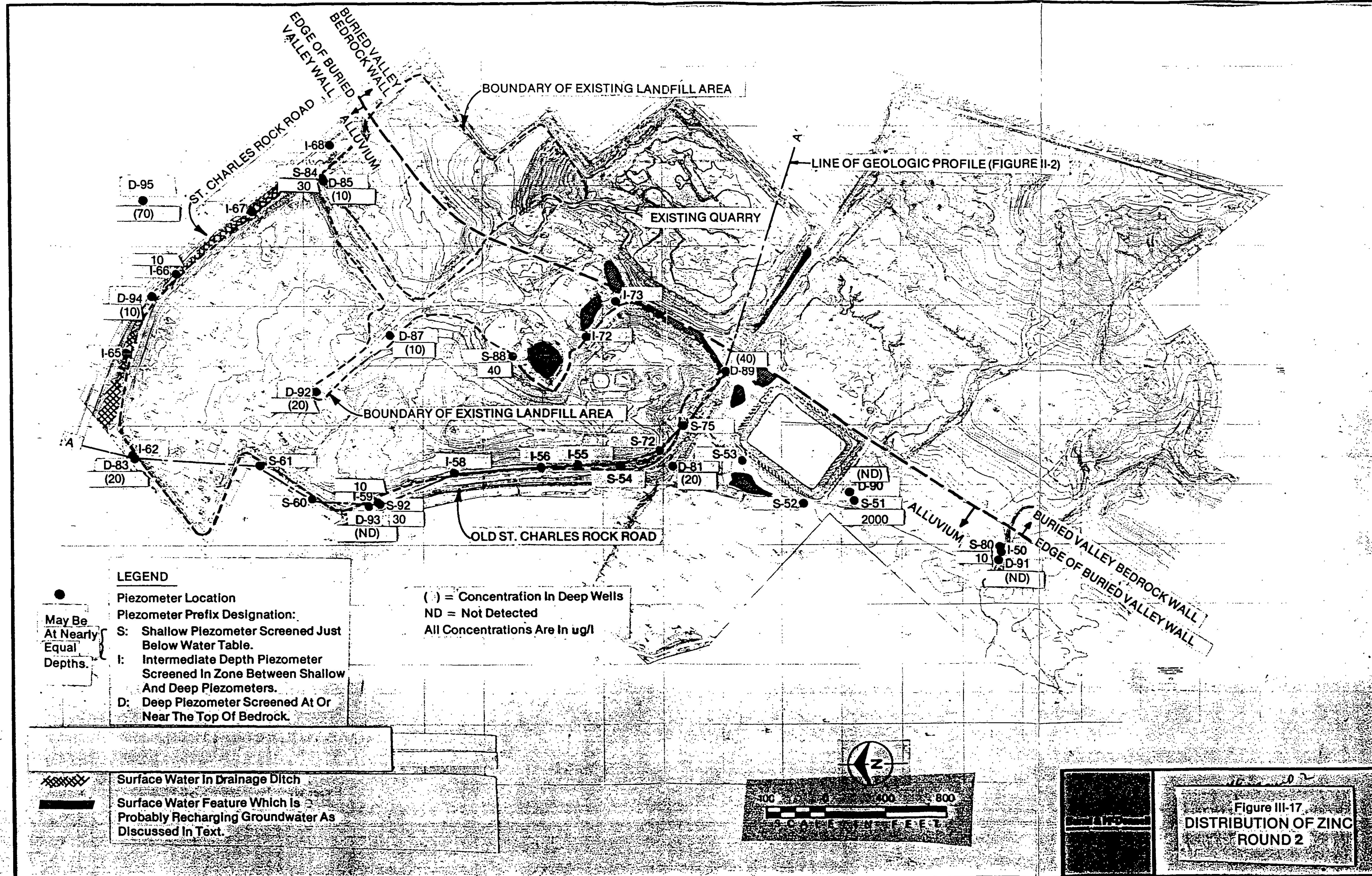


Figure III-17
DISTRIBUTION OF ZINC
ROUND 2

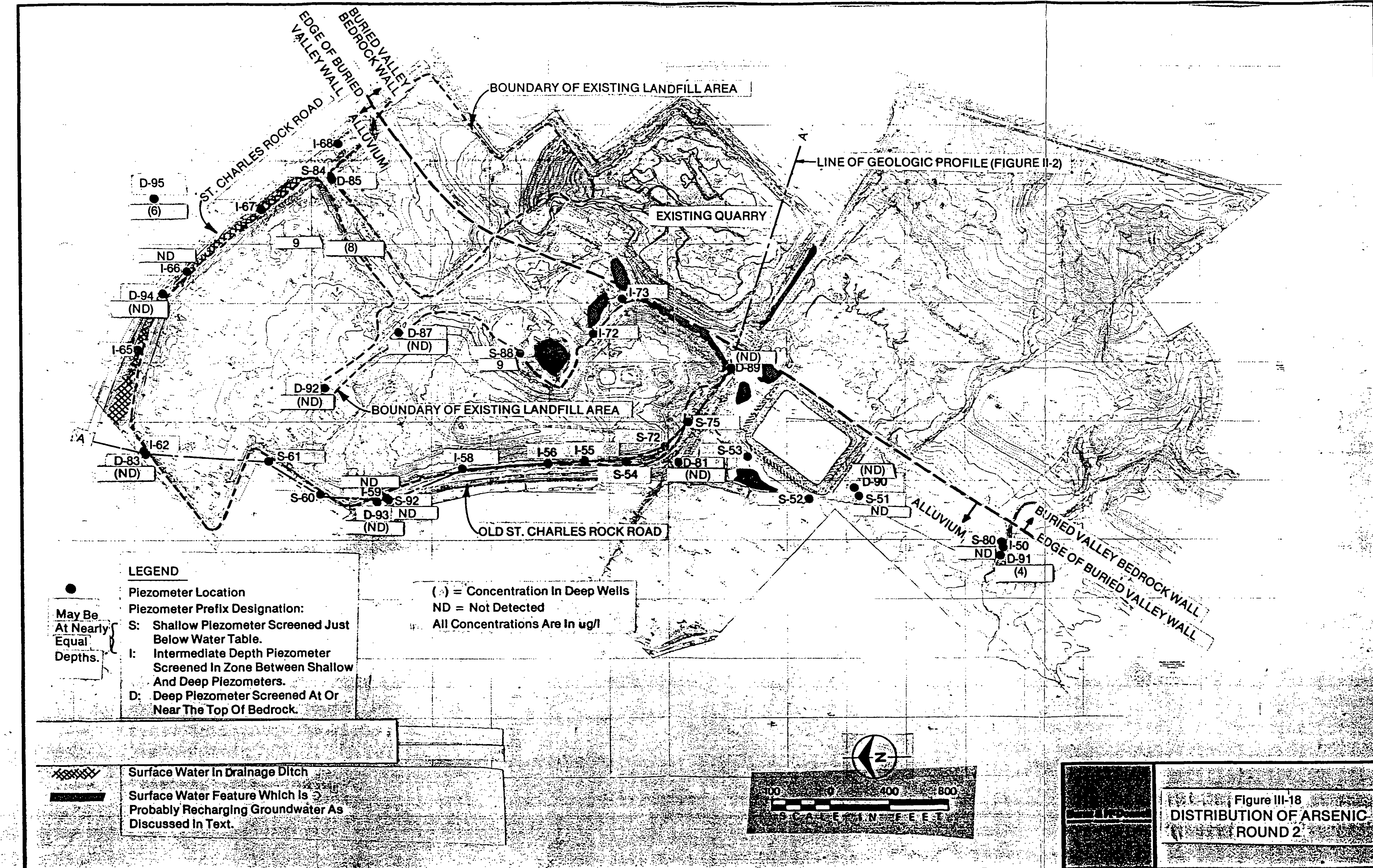


Figure III-18
DISTRIBUTION OF ARSENIC
ROUND 2

NUREG/CR-2722

Radiological Survey of the West Lake Landfill St. Louis County, Missouri

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Prepared for
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Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
NRC FIN B6901

Exhibit 14-C

ABSTRACT

This report presents the results of a radiological survey of the West Lake Landfill, St. Louis County, Missouri, performed by Radiation Management Corporation during the spring and summer of 1981. Measurements were made to determine external radiation levels, concentrations of airborne contaminants and the identity and concentrations of subsurface deposits. Results indicate that large volumes of uranium ore residues, probably originating from the Hazelwood, Missouri, Latty Avenue site, have been buried at the West Lake Landfill. Two areas of contamination, covering more than 15 acres and located at depths of up to 20 feet below the present surface, have been identified. There is no indication that significant quantities of contaminants are moving off-site at this time.

LIST OF FIGURES

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LIST OF TABLES

I. INTRODUCTION

In August 1980, Radiation Management Corporation (RMC), under contract to the U. S. Nuclear Regulatory Commission (NRC), performed radiological evaluations of four burial grounds[1]. The first of these sites selected for evaluation was the West Lake Landfill in St. Louis County, Missouri. An initial site visit was completed in August 1980, and a preliminary radiological survey was completed in November 1980. The detailed radiological evaluation was performed in the spring and summer of 1981.

The purpose of this survey was to clearly define the radiological conditions of the West Lake Landfill site. The results of this survey should be sufficient to allow an engineering evaluation to be performed to determine whether remedial actions should and can be taken.

The methods used to evaluate this site include the following:

1) measurement of external gamma exposure rates 1 meter above the surfaces and beta-gamma count rates 1 cm above surfaces;
2) measurement of radionuclide concentrations in surface soils;
3) measurement of radionuclide concentrations in subsurface deposits;
4) measurement of gross activity and

radionuclide concentrations in surface and subsurface water samples;

5) measurement of radon flux emanating from surfaces;

6) measurement of airborne radioactivity; and

7) measurement of gross activity in vegetation.

These measurements were performed on-site using two mobile facilities designed by RMC. A small number of samples were returned to the RMC radiological laboratories in Philadelphia for analysis for nuclides which could not be detected in the field, and for quality assurance checks on the field measurements. A set of reference background measurements were made at three locations in the St. Louis area, near West Lake Landfill. In addition, a series of non-radiological measurements were performed to identify the possible presence of toxic or hazardous agents known or believed to have been buried at this landfill.

II. SITE CHARACTERISTICS

The West Lake Landfill is located on St. Charles Rock Road just west of the Taussig Road intersection in Bridgeton, Missouri. The site is about one (1) mile northwest of Route 270 and approximately 1-1/2 miles east of the Missouri River. It is located in a combined rural-industrial area, and is bounded on three sides by farm land and on the fourth by St. Charles Rock Road, beyond which are located several commercial and industrial establishments. The nearest residential area is a trailer park located about 3/4 of a mile southeast of the landfill.

The site is approximately 200 acres and consists of a quarry, stone and limestone processing and storage areas, and several active and inactive landfills (Figure 1), which are open to the public during normal working hours. West Lake Landfill keeps track of entries for the purpose of assessing fees for disposal; however, access is not controlled for other reasons. Users are prohibited from disposing of hazardous materials at this site by current Missouri state law.

Studies indicate the landfill is on the alluvial floodplain of the Missouri River. This fact prompted the Missouri Geological Survey, in 1973, to propose classification of the site as hazardous under the then existing operating procedures. In addition, samples from perimeter monitoring wells taken in 1977 and 1978 indicated some movement of leachate into monitoring wells, based on chemcial (not radiological) analyses. However, recent studies by the Department of Natural Resources indicate little or no surface or sub-surface movement of materials from the site[2]. Leachate from the active sanitary landfill is collected and treated on-site. At this time there is no evidence of significant ground water contamination; however, geological reports indicate a potential for such problems.

In May 1976, the St. Louis Post-Dispatch[3] printed a story alleging that radioactive material had been erroneously dumped in the West Lake Landfill in 1973. The source of this material was identified as the Cotter Corporation, Hazelwood, Missouri, Latty Avenue Site.

An NRC investigation conducted by Region III in 1976 [4] concluded that about 7 tons of U3O8, contained in 8700 tons of leached barium sulfate residues, had been mixed with about 39,000 tons of soil at Latty Avenue and the entire volume disposed of at the West Lake Landfill. The earlier study by the Post- Dispatch (1976) claimed only 9000 tons (presumably the leached barium sulfate residues) had been buried, and that the remaining material had not been disposed of at West Lake. The Post-Dispatch alleged that the contractor hauling the dirt had admitted falsifying invoices for about 40,000 tons of soil. Discussions with site personnel indicated that a large quantity of soil from Latty Avenue had indeed been dumped at West Lake, although the exact amount was unknown.

A fly-over radiological survey (ARMS flight), performed for the NRC in 1978, showed external radiation levels as high as 100 uR/hr in the area indicated by West Lake personnel as containing the Latty Avenue material. In addition, this survey revealed another possibly contaminated zone in a fill area previously believed to be "clean".

Figure 2 shows the results of the 1978 aerial survey. The area in the southeast fill was believed to contain Latty Avenue material, while that on the northeast boundary was previously unidentified.

In addition to radioactive material, it is known that hazardous chemical wastes have been disposed of at this landfill. Since disposal was unregulated prior to 1973, little is known about the actual materials present. However, it is believed that aside from normal landfill materials, there are chemical industrial wastes in the landfill.

Among the chemical wastes believed to be present are:

waste ink	halogenated intermediates
pigments	aromatics
oily sludges	oils
esters	wastewater sludges
alcohols	heavy metals
insecticides	herbicides

III. RADIOLOGICAL SURVEY METHODS

(A) Measurement of External Radiation Levels

The two areas of contamination were gridded and surveyed for both gamma radiation levels at one meter above the surface, and beta-gamma levels at the ground surface.

The basic pattern at each contaminated area was survey blocks defined by a 10 meter grid system. External gamma levels at one meter were recorded at each grid point (i.e. at each intersection of two grid lines). Initially, precise exposure rate measurements at a few specially selected grid points were made with a sensitive Tissue Equivalent Ionization Chamber System (described in Appendix I). At the same time, NaI scintillation detector (described in Appendix I) measurements were made and a conversion factor for the NaI count rate versus uR/hr established (See Figure I-3). Once this factor was confirmed, the scintillation detector was used for all grid measurements at relatively low exposure rates. For the few higher rates encountered, a Geiger-Mueller portable survey instrument was used.

At each grid point, an end window G-M tube (described in Appendix I) was used for surface measurements. An open and closed window reading was made at 1 cm, and the ratio of the two used to indicate the presence or absence of surface contamination.

(B) Measurement of Surface Radioactivity

Based on the external surface measurements, surface soil samples were collected for analysis from both contaminated areas. These samples were collected from locations on-site where surface deposits were indicated, as well as locations where the drainage characteristics indicated the possibility that radioactive materials may have been carried or washed away from original burial locations. The soils were dried, ground and sealed in 500 ml aluminum cans for counting on the intrinsic germanium (IG) gamma ray spectroscopy system (described in Appendix I).

Vegetation on-site consisted only of grass and common weeds. Off-site, crops are grown on farm land immediately north and west of the site. Since the possibility of contamination exists here, crop samples were collected where indicated by surface measurements. These samples were dried, crushed and counted as described above.

(C) Measurements of Subsurface Radioactivity

Since it was known that most, or all, of the radioactive materials at the West Lake Landfill have been buried, extensive subsurface monitoring and sampling was required. The purpose of this activity was to determine the depth and lateral extent of subsurface contamination.

A series of holes through and bordering the contaminated deposits were drilled and lined with 4-inch PVC casing. Each hole was then scanned with a 2" by 2" NaI(Tl) scintillation detector and rate meter system.

Representative holes were then logged using an _in situ_ gamma measurement system consisting of an intrinsic germanium (IG) detector coupled to a multichannel analyzer (described in Appendix I). Field analyses were then made, both qualitatively and quantitatively, thereby eliminating time consuming laboratory analyses and expensive core sampling of each hole. Measurement intervals ranged from 6" to 24", depending upon factors such as hole depth and activity. An occasional core sample was taken to verify the _in situ_ measurements and to confirm the presence or absence of non-gamma emitting nuclides such as Th-230.

(D) Measurement of Radioactivity in Water

Whenever possible, water samples were taken from the bore holes and two off-site monitoring wells. Samples were also taken from standing water, run off water, and leachate liquids. Samples were filtered, evaporated and counted for gross activity, or were filtered and sealed in Marinelli beakers for gamma spectroscopic analysis.

(E) Measurement of Airborne Radioactivity

Measurements were made to determine if the material buried on-site is a source of airborne radioactivity. The isotopes of concern are Ra-226, Ra-224 and/or Ra-223, which decay to Rn-222, Rn-220 and [illegible] emanation of radon from the soil, and movement of radon and daughters off-site.

These measurements may be used to determine Rn flux emanation as a source term for off-site dose calculations, or as an indication of the presence of radium at or below the surface. Additional on-site Rn daughter measurements were made to perform working level (WL) determinations.

Radon flux measurements which are to be related to off-site dose calculations were of no value for Rn-219, due to its very short (4 sec) half-life. Therefore, only its long-lived daughters are of concern for off-site exposures. In addition, if the parent (Ra-223) is not within a few millimeters of the surface, Rn-219 is not likely to emanate into the atmosphere [5].

Due to these considerations, only Rn-222 and Rn-220 fluxes were measured. The principal measurement technique was collection of a filtered gas sample from an accumulator and subsequent counting in a radon gas analyzer (described in Appendix 1). Sequential alpha counting, starting immediately after sampling, allowed separation of Rn-222 from Rn-220 (if present). Repetitive samples were taken from several locations during the survey period in an effort to evaluate the effect of fluctuations between individual measurements, due to varying meteorological and soil conditions. A second method using charcoal canisters was also employed as a check on the accumulator technique.

The presence of Rn-219 was determined by detection of its daughters deposited on high volume particulate sample filters, using gamma spectroscopy. Total Rn daughter levels were also estimated by gross alpha activity on particulate filters. From this, a total working level (WL) determination was made.

IV. SURVEY RESULTS

(A) External Radiation Levels

Two areas of elevated external radiation levels have been identified by this survey. Figure 3 shows the two areas as they existed in November, 1980, at the time of the preliminary RMC site survey. As can be seen, both areas contained locations where levels exceeded 100 uR/hr at 1 meter, and in Area 2, gamma levels as high as 3-4 mR/hr were detected. The total areas exceeding 20 uR/hr were about 3 acres in Area 1 and 9 acres in Area 2.

External gamma levels measured in May and July of 1981 are shown in Figure 4. These levels had decreased significantly, especially in Area 1, due to continuing activities at the landfill. In both cases, contaminated areas were covered with additional fill material. RMC estimates that about 4 feet of sanitary fill was added to the entire area denoted as Area 1, and that an equal amount of construction fill was added to most of Area 2. As a result, only a small region of a few hundred square meters in Area 1 exceeds 20 uR/hr. In Area 2, the total area exceeding 20 uR/hr decreased by about 10%, and the highest levels are now about 1600 uR/hr, near the Shuman building.

Both areas were marked off in a 10 m by 10 m grid, based on a north-south line erected from a boundary marker, as laid out by a surveying team, as a reference line. Grid designations are shown in Figures 5 and 6. At each grid point, external gamma levels at 1 m, and beta-gamma count rates at 1 cm, were measured. Results of these measurements are given in Tables 1 and 2.

Beta-gamma measurements at 1 cm from the surface are given in count rates, rather than dose rates, due to the difficulty in measuring beta dose rates accurately with end window G-M tubes. Large differences between open- and closed-window readings indicate the possibility of surface contamination. Little surface contamination was found in Area 1, as would be expected due to fresh land fill cover over nearly the entire area.

Several isolated spots of surface contamination in Area 2 were indicated by beta-gamma measurements, and later confirmed by surface soil sampling. These spots are generally located near the northwest edge of Area 2, which includes the berm that bounds the landfill at that point. Some erosion and run-off is evident along the top of the fill, apparently uncovering deposits of radioactive material in the process. Thus far, fresh construction fill has not been added here, due to the inaccessibility of these spots.

A second region of surface contamination is found just north of the Shuman building. It is not clear why material appears on the surface here, except that it is possible that some digging or excavation has occurred here in the past.

(B) Surface Soil Analyses

A total of 61 surface soil samples were gathered and analyzed on-site for gamma activity. Samples were normally stored 10 to 14 days to allow ingrowth of radium daughters. Concentrations of U-238, Ra-226 (from PB-214 and Bi-214), Ra-223, Pb-211 and Pb-212 were determined for each sample. Locations of surface soil samples are shown in Figures 7 and 8, and the results in Table 3.

In all soil samples nothing other than uranium and/or thorium decay chain nuclides and K-40 was detected. Off-site background samples were on the order of 2 pCi/g for Ra-226. On-site samples ranged from about 1 to 21,000 pCi/g Ra-226, and from less than 10 to 2,100 pCi/g U-238. In those cases where elevated levels of Ra-226 were detected, the concentrations of U-238 were generally anywhere from a factor of 2 to 10 lower. In cases of elevated sample activity, daughter products of both U-238 and U-235 were found.

In general, surface activity was limited to Area 2, as indicated by the surface beta-gamma measurements. Only two small regions in Area 1 showed contamination, both located near the access road across from the site offices.

In addition to on-site gamma analyses, a set of 12 samples were submitted to the RMC radiochemical laboratories for thorium and uranium radiochemical determinations. The results of these measurements are shown in Table 4. They show that all samples contain high levels of Th-230. The ratio of Th-230 to Ra-226 (Bi-214) is about 20, which indicates an "enrichment" of thorium in these residues, as discussed in Section V.

(C) Subsurface Soil Analysis

Subsurface contamination was assessed by extensive "logging" of holes drilled through the landfill at locations known or thought to contain radioactive materials. Several holes were drilled in areas known to contain contamination, then additional holes were drilled outward in all directions until no further contamination was encountered. A total of 43 holes were drilled, (11 in Area 1 and 32 in Area 2), including 2 off-site water monitoring wells. All holes were drilled with a 6-inch auger and lined with 4-inch PVC casing. The location of these auger holes is shown in Figures 9 and 10.

Each hole was scanned with a 2-inch by 2-inch NaI(Tl) detector and rate meter system for an initial indication of the location of subsurface contamination. Based on the initial scans, certain holes were selected for detailed gamma logging using the IG detector and MCA. A total of 19 holes were logged in this manner.

The results of the NaI(Tl) counts and IG analyses are shown in Table 5. Concentrations of Bi-214, as determined by the IG system, ranged from less than 1 to 19,000 pCi/g. For those holes where both NaI(Tl) and IG counts were made, a good correlation between gross NaI(Tl) counts and Ra-226 concentrations, as determined by in situ analysis of the daughter Bi-214 by the IG system, was found. Figure 11 is a plot of NaI(Tl) count rate versus IG determination of Ra-226, and shows a nearly linear relationship between the two at concentrations near the action criteria. The conclusion is that the NaI(Tl) data is a good estimation of the Ra-226 concentration in soil, so long as the radionuclide mix is reasonably constant. In the case of West Lake Landfill, this has been shown to be the case.

It was determined that the subsurface deposits extended beyond areas where surface radiation measurements exceeded action criteria. Figures 12 and 13 show the approximate area of subsurface contamination versus the area of elevated surface radiation levels. The total difference in areas is on the order of 5 acres.

The variations of contamination with depth are shown in Figure 14. As can be seen, the surface elevations vary by about 20 feet, with the highest elevations at locations of fresh fill. Contamination (> 5 pCi/g Ra-226) is found to extend from the surface, in several areas, to a depth of about 20 feet below surface, in two cases. In general, the subsurface contamination appears to be a continuous single layer, ranging from two to fifteen feet thick, located between elevations of 455 feet and 480 feet and covering 16 acres total area.

In Figures 15-19, representations of the subsurface deposits are provided based on auger hole measurements. These representations are consistent with the operating history of the site, which suggests that the contaminated material was moved onto the site within a few days' time, and spread as cover over fill material. Thus, one would expect a fairly continuous, thin layer of contamination, as indicated by survey results.

(D) Water Analyses

A total of 37 water samples were taken during this survey, 4 in the fall of 1980, and the remainder in the spring and summer of 1981. Results of water analyses are shown in Table 6.

None of the sample alpha activities exceeded the MPC for Ra-226 (the most restrictive nuclide present) in water for unrestricted areas. Only one sample exceeded the EPA gross alpha activity guidelines for drinking water and that was a sample of standing water near the Shuman building. Several samples, including all the leachate treatment plant samples, exceeded the EPA gross beta drinking water standards. Subsequent isotopic analyses indicated that all the beta activity can be attributed to K-40. None of the off-site samples exceeded either EPA standard.

(E) Airborne Radioactivity Analyses

Both gaseous and particulate airborne radioactivity were sampled and analyzed during this study. Since it was known that the buried material consisted partially or totally of uranium ore residues, the sampling program concentrated on measuring radon and daughters in the air. Two methods were used: the first was a scintillation flask method for radon gas and the second was analysis of filter paper activity for particulate daughters.

A series of grab samples using the accumulator method (described in Appendix I) were taken between May and August of 1981.. A total of 111 samples from 32 locations were collected. Results can be found in Table 7. Radon flux levels ranged from 0.2 pCi/sq.m-s in low background areas to 868 pCi/sq.m-s in areas of surface contamination.

At three locations, repetitive measurements were made over a period of two months. These results are plotted in Figure 20. As can be seen, significant fluctuations were observed at two locations. The fact that these fluctuations were real and not measurement artifacts was later confirmed by duplicate charcoal canister samples, as described below.

A total of 35 charcoal canister samples were gathered at 19 locations over a three month period. The results are listed in Table 8, and show levels ranging from 0.3 pCi/sq.m-s to 613 pCi/sq.m-s. On 24 different occasions, the charcoal canisters and accumulator were placed in essentially the same locations, at the same time, for duplicate sampling. The results of this side-by-side study are presented in Table 9, and show generally good correlation between the two methods.

A set of 10 minute high volume particulate air samples were taken to determine both short-lived radon daughter concentrations and long-lived gross alpha activity. Sample results are shown in Table 10. The highest levels were detected in November, 1980, near and inside the Shuman building. Only these two samples exceed MPC for radon daughters for unrestricted areas.

In addition to the routine 10 minute samples, five 20 minute high volume air samples were taken and counted immediately on the IG gamma spectroscopy system. The purpose of these analyses was to detect the presence of Rn-219 daughters. All samples were taken near surface contamination and are listed in Table 11. In addition to Rn-222 daughter gamma activities, Rn-219 daughters were detected by measuring the low abundance gamma rays of Pb-211. Concentrations of Rn-219 daughters ranged from 6E-11 uCi/cc to 9E-10 uCi/cc.

(F) Vegetation Analysis

Vegetation samples included weed samples from on-site locations and farm crop samples (winter wheat) from the northwest boundary of the landfill. This location was chosen due to possible run off from the fill into the farm field. No elevated activities were found in these samples.

(G) Non-Radiological Analysis

Six composite samples were submitted to the RMC Environmental Chemistry Laboratory for priority pollutant analysis. Five samples were taken from auger holes (one from Area 1 and four from Area 2) and the sixth from the West Lake leachate treatment plant sludge. The results, shown in Table 12, indicate a significant presence of organic solvents in Area 2 samples. The results of the leachate sludge analysis were not as high as any of the soil samples.

A chemical analysis of radioactive material from both areas was also performed by RMC labs and reported in Table 13. Results show elevated levels of barium and lead in most cases.

(H) Background Measurements and Remedial Action Criteria

Various off-site locations were selected for reference background measurements. The results of these measurements are summarized in Table 14, and can be compared with the established NRC target criteria for remedial action, for this project, shown in Table 15.

V. CONCLUSIONS

Based on survey results, it is evident that the West Lake Landfill contains two areas of surface and/or subsurface contamination. These deposits yield detectable external radiation levels in both areas. However, only an area of less than 0.1 acre in Area 1 exceeds 20 uR/hr, while about 8 acres in Area 2 exceeds the 20 uR/hr criteria. The highest reading detected in the most recent survey was 1.6 mR/hr in Area 2, near the Shuman Building.

Analyses of soil samples from both areas, as well as in situ measurements, show that the contaminants present at West Lake consist of uranium and uranium daughters. Chemical analyses reveal high concentrations of barium and sulfates in the radioactive deposits. These results tend to confirm the reports that this contaminated material is uranium and uranium ore, contained in leached barium sulfate residues, and presumably transferred from the Latty Avenue Site in Hazelwood, Missouri.

Analysis of soils also shows a high Th-230 to Ra-226 ratio. Since the target criteria for Ra-226 is the most restrictive of those contaminants present, it has been assumed that Ra-226 would be the controlling radionuclide for remedial action determinations. However, since Th-230 levels may be from 5 to 50 times higher than Ra-226 concentrations, this assumption may be erroneous. It is likely that high separation of both uranium and radium from the ores, thus "depleting" the ores of uranium and radium, or, "enriching" the residues in thorium. This "enrichment" would also be evident in the U-235 chain, despite the short half-lives of Th-227 and Th-231, since the long-lived Pa-231 would remain in the residues. The concentrations of Pa-231, inferred from Ra-223 determinations, are also shown to be high.

Auger hole measurements show that nearly all the contamination present is located below the landfill surface, although a few locations near the northwest berm in Area 2 show surface, or near surface, deposits. These deposits range from 2 to 15 feet in thickness, and appear to form a contiguous layer covering an area of about 14 acres (68,000 sq.yd.) in Area 2 and about 2 acres (10,000 sq.yd.) in Area 1. If an average thickness of 2 yards is assumed, the estimated total volume is 150,000 cu.yd., which corresponds to roughly 170,000 tons of soil. This implies that if the source of contamination was the Latty Avenue material, the original volume of 40,000 tons has been diluted by a factor of about 4, which is not unexpected, with the continual movement and spreading of materials during fill operations.

As discussed previously, the auger hole measurements detected deposits exceeding 5 pCi/g Ra-226 within a few feet of the surface, in areas where surface external radiation levels were indistinguishable from normal background levels.

These results confirm suspected difficulties in detecting buried materials with surface measurements, even when using relatively sensitive portable survey instruments.

At no time has radioactivity in off-site water samples been above any applicable guidelines. These results indicate that the buried ore residues are probably not soluble and are not moving off-site via ground water. On-site samples have shown some gross beta activity above EPA drinking water guidelines (attributable to K-40); however, gross alpha and Ra-226 levels are within limits. The absence of significant contamination in the leachate liquid or sludge is consistent with the implication that the buried material is not moving through the landfill.

As would be expected, radon flux emanation rates were highest at locations of surface, or near surface, contamination. At locations where the material is covered by several feet of fill, flux levels are near background rates.

Particulate air samples established indicated the presence of Rn-222 and Rn-219 daughters near the locations of surface deposits. However, concentrations are very low, and do not exceed allowable levels for unrestricted areas, except in one location. In general, cover of a few feet of fill reduces airborne concentrations to near background levels.

The fact that West Lake is an active landfill presents several serious problems for performing radiological assessments and remedial actions. In the first place, as the landfill conditions change, so do the surface radiological characteristics. These changes were evident in the reduction of radiation levels in Area 1 between November 1980, and May 1981. It is possible that future landfill activities will obscure all detectable surface radiation levels at the site.

REFERENCES

[1] U. S. Nuclear Regulatory Commission Letter Contract: NRC-02-080-034, August 13, 1980.

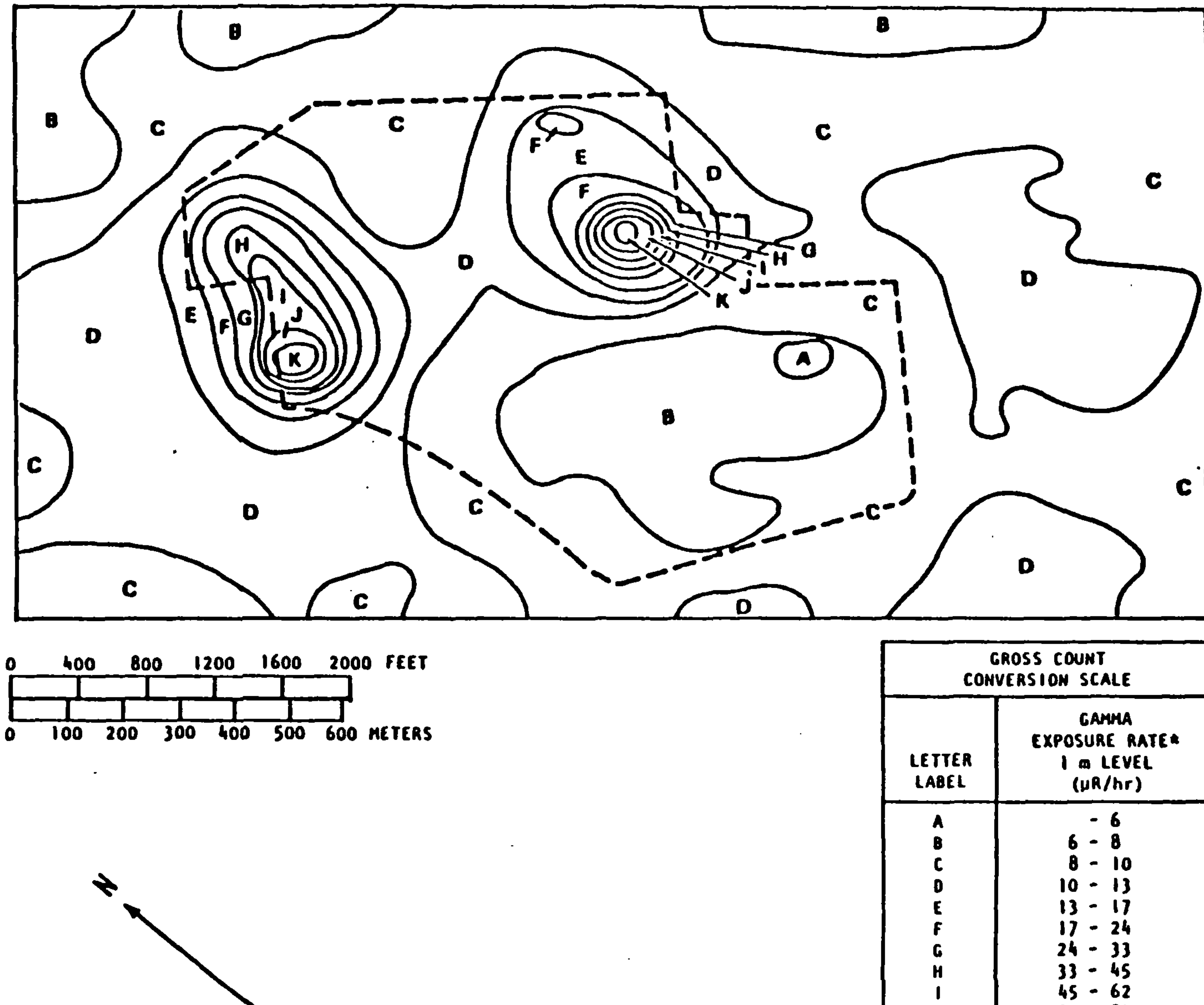
[2] Missouri Department of Natural Resources, "Groundwater Investigation, West Lake Landfill, St. Louis County, September 30 through October 1, 1980."

[3] St. Louis Post-Dispatch, May 30, 1976.

[4] U. S. Nuclear Regulatory Commission, Office of Inspection and Enforcement, Region III, IE Inspection Report No. 76-01, June and August, 1976.

[5] Crawford, D. J., "Radiological Characteristics of Rn-219", Health Physics, Vol. 39, No. 3, pp. 450.

Figure 1. Aerial view of West Lake Landfill, St. Louis County, Missouri



GROSS COUNT CONVERSION SCALE	
LETTER LABEL	GAMMA EXPOSURE RATE* 1 m LEVEL (μR/hr)
A	- 6
B	6 - 8
C	8 - 10
D	10 - 13
E	13 - 17
F	17 - 24
G	24 - 33
H	33 - 45
I	45 - 62
J	62 - 84
K	84 - 116

*AVERAGED OVER DETECTABLE FIELD-OF-VIEW AT 60 m ALTITUDE AND EXTRAPOLATED TO THE 1 m LEVEL INCLUDES 3.7 μR/hr COSMIC RADIATION.

- - - - - - ESTIMATED LANDFILL OUTLINE

Figure 2. West Lake Landfill aerial survey isopleths.

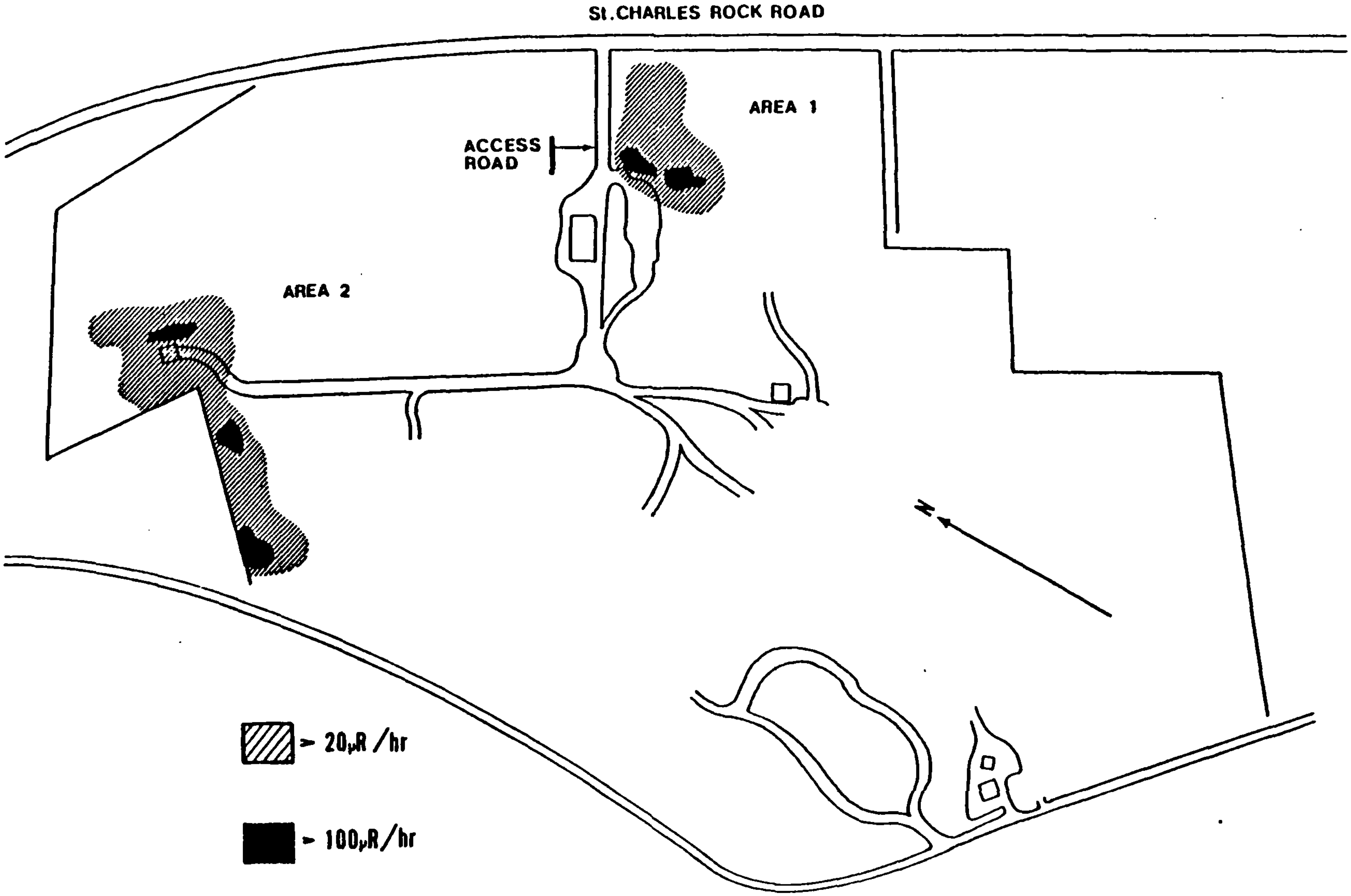


Figure 3. External gamma radiation levels, November 1980.

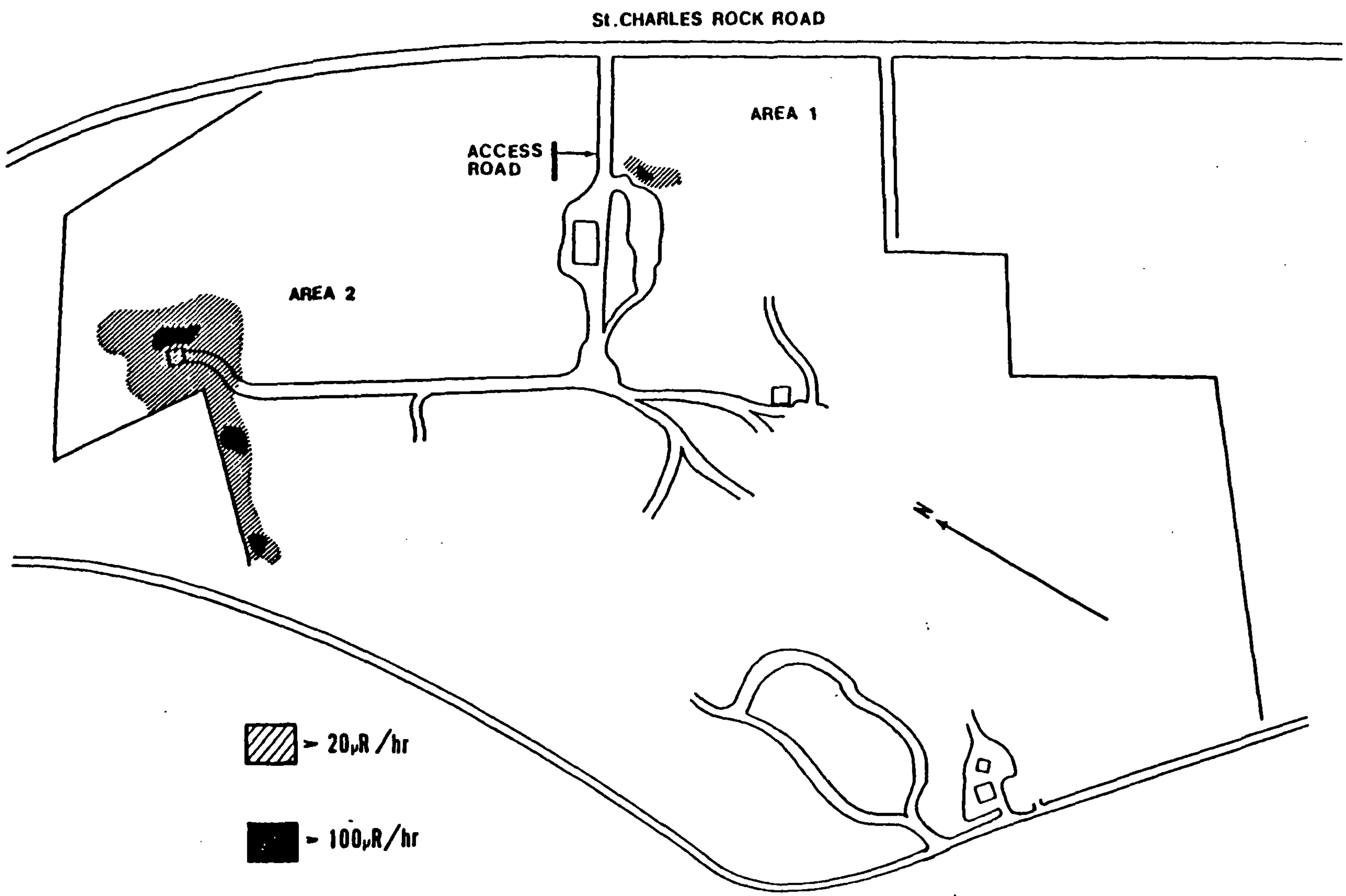


Figure 4. External gamma radiation levels, May, 1981

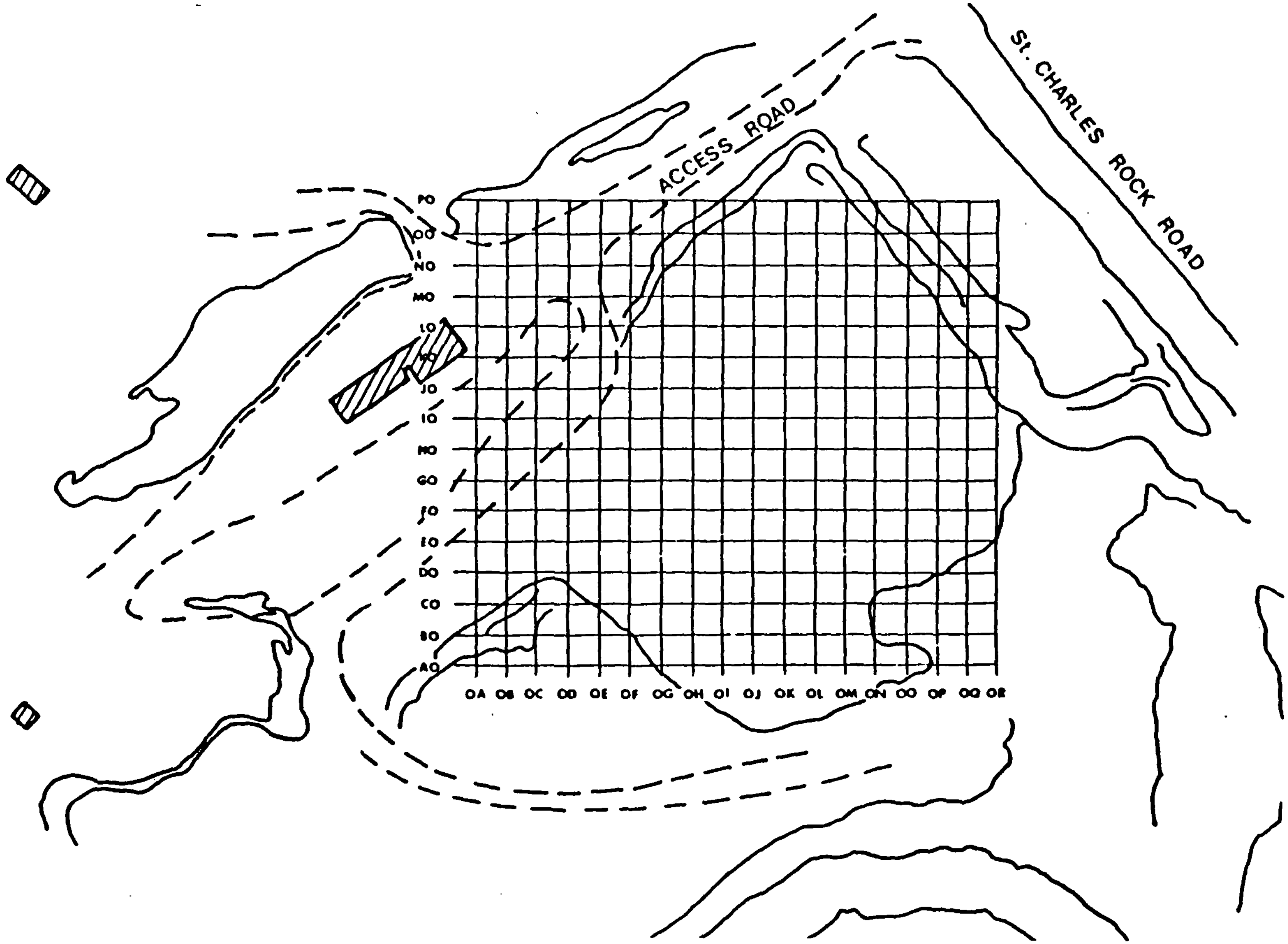


Figure 5. Grid locations for radiological survey, Area 1.

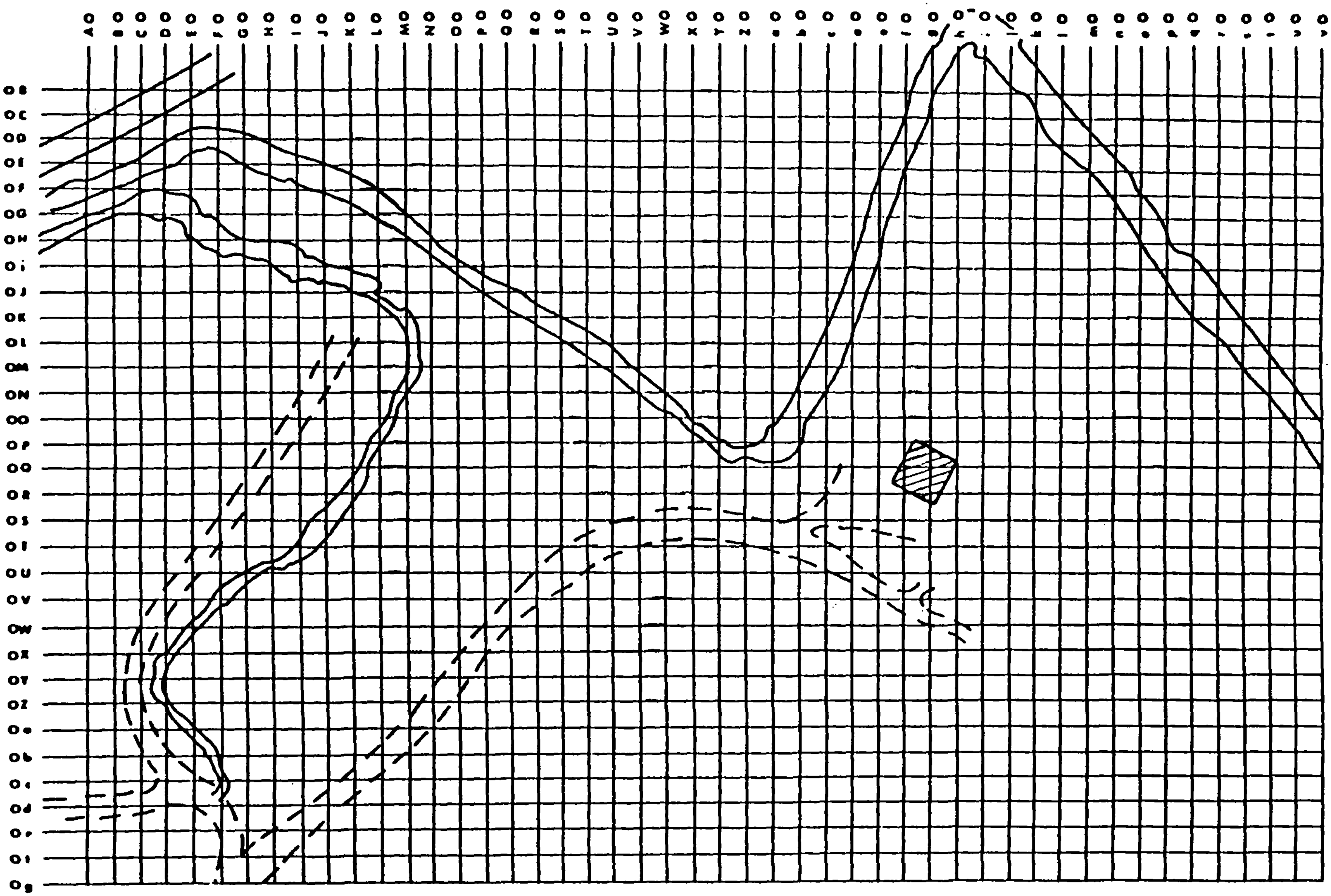


Figure 6. Grid locations for radiological survey, Area 2.

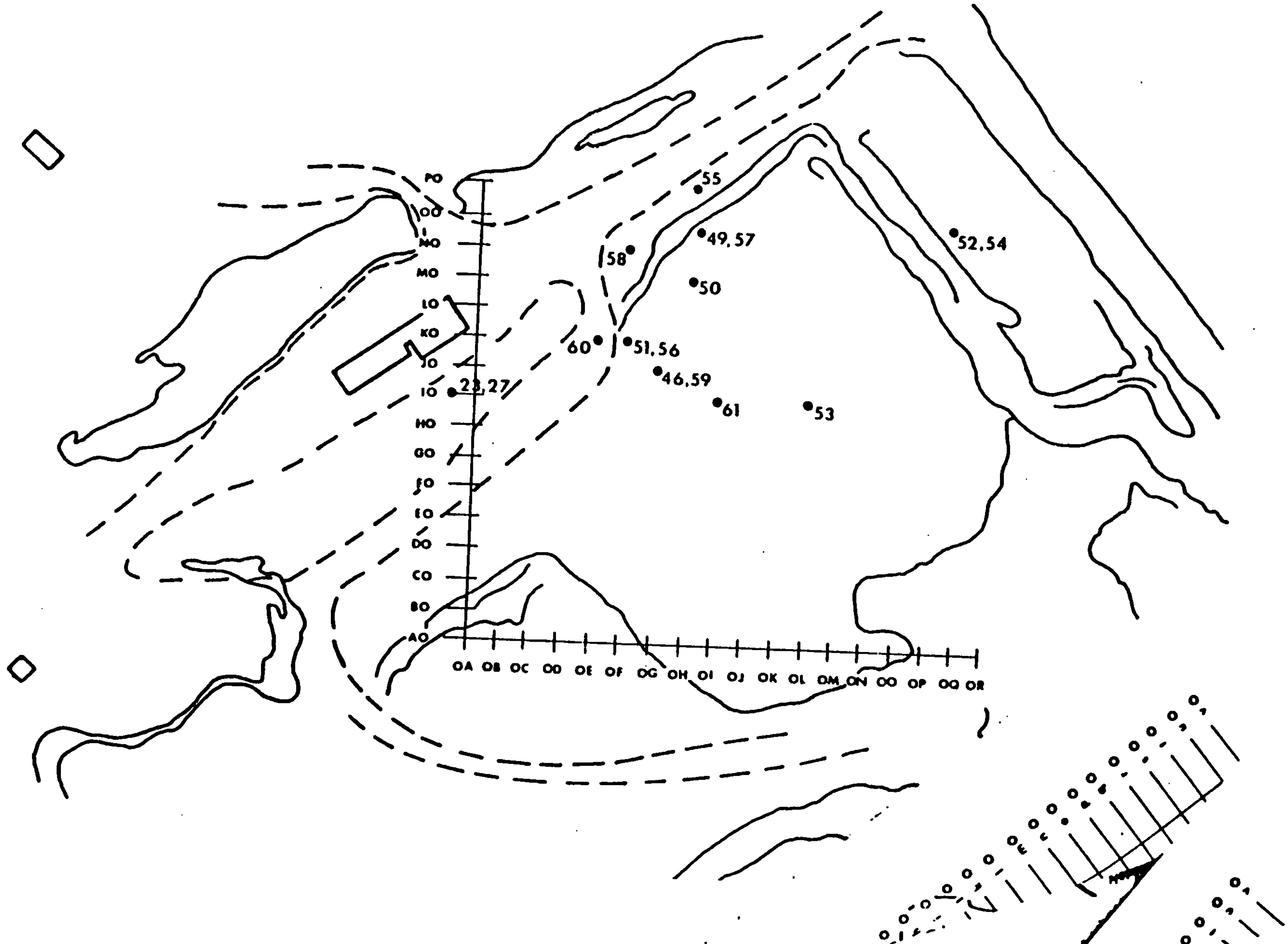


Figure 7. Location of surface ... and B-B indicate cros... ...16.

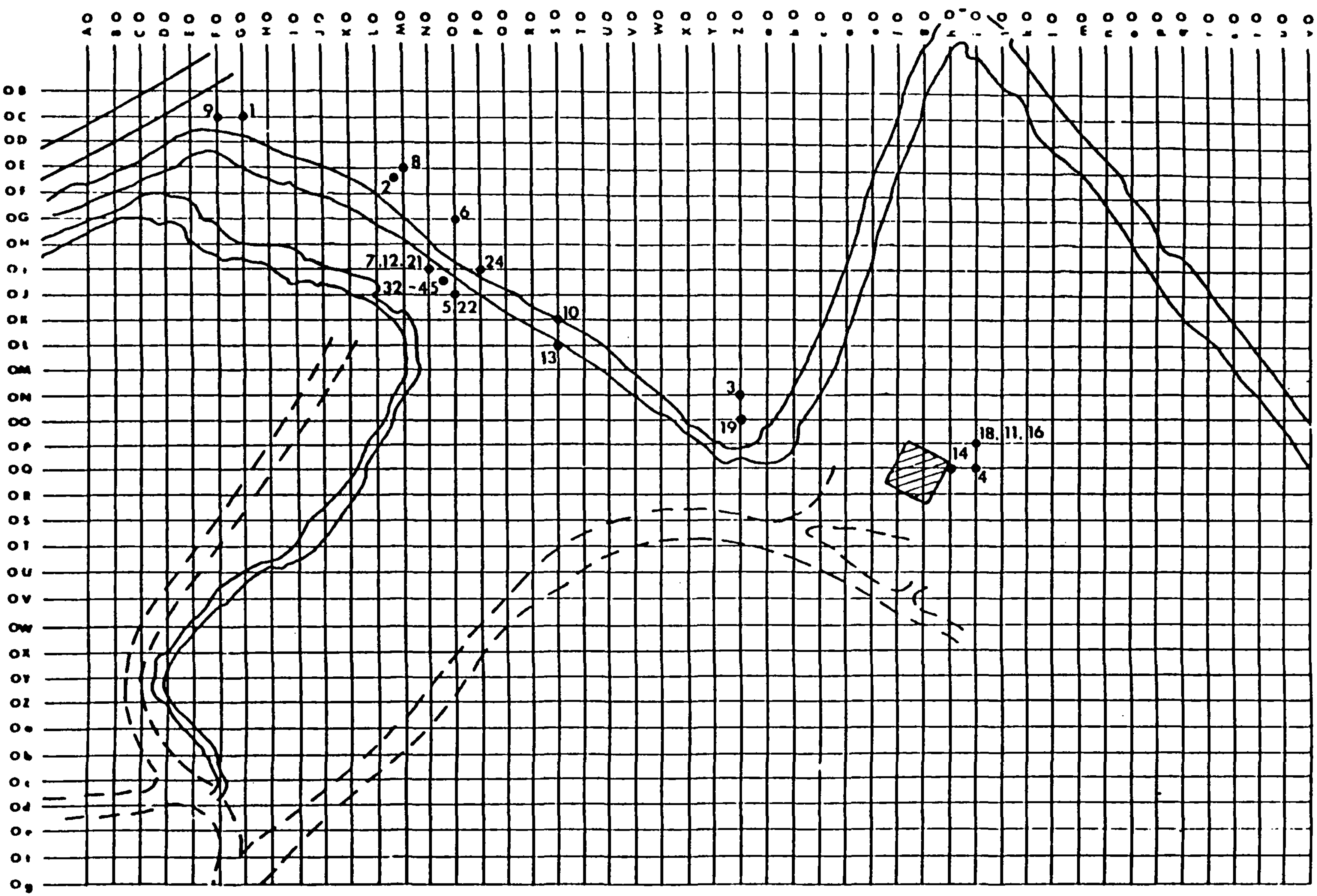


Figure 8. Location of surface soil samples, Area 2.

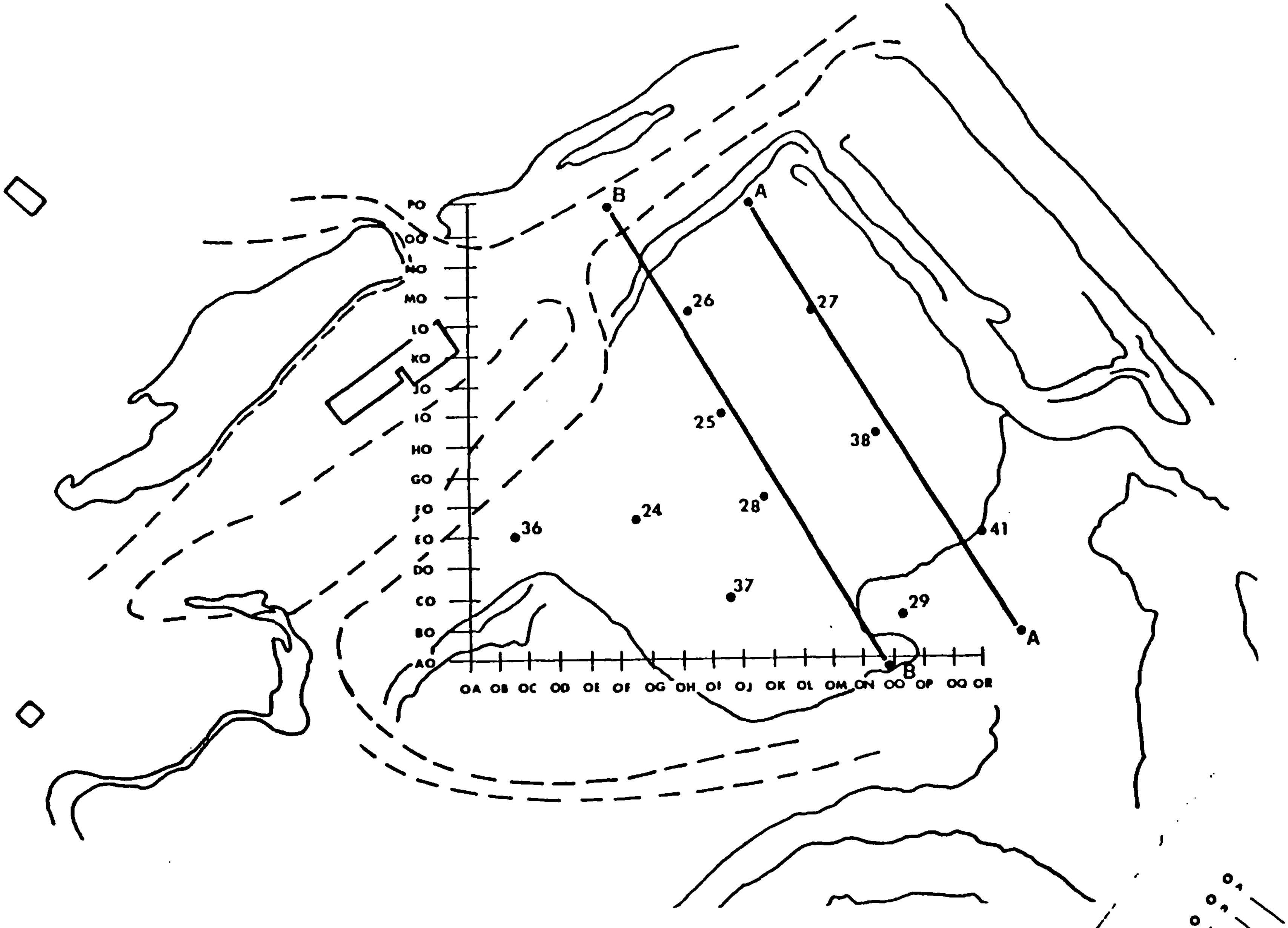


Figure 9. Location of auger holes, Area 1. Lines A-A and B-B indicate cro
sectional areas shown in Figures 15 and 16.

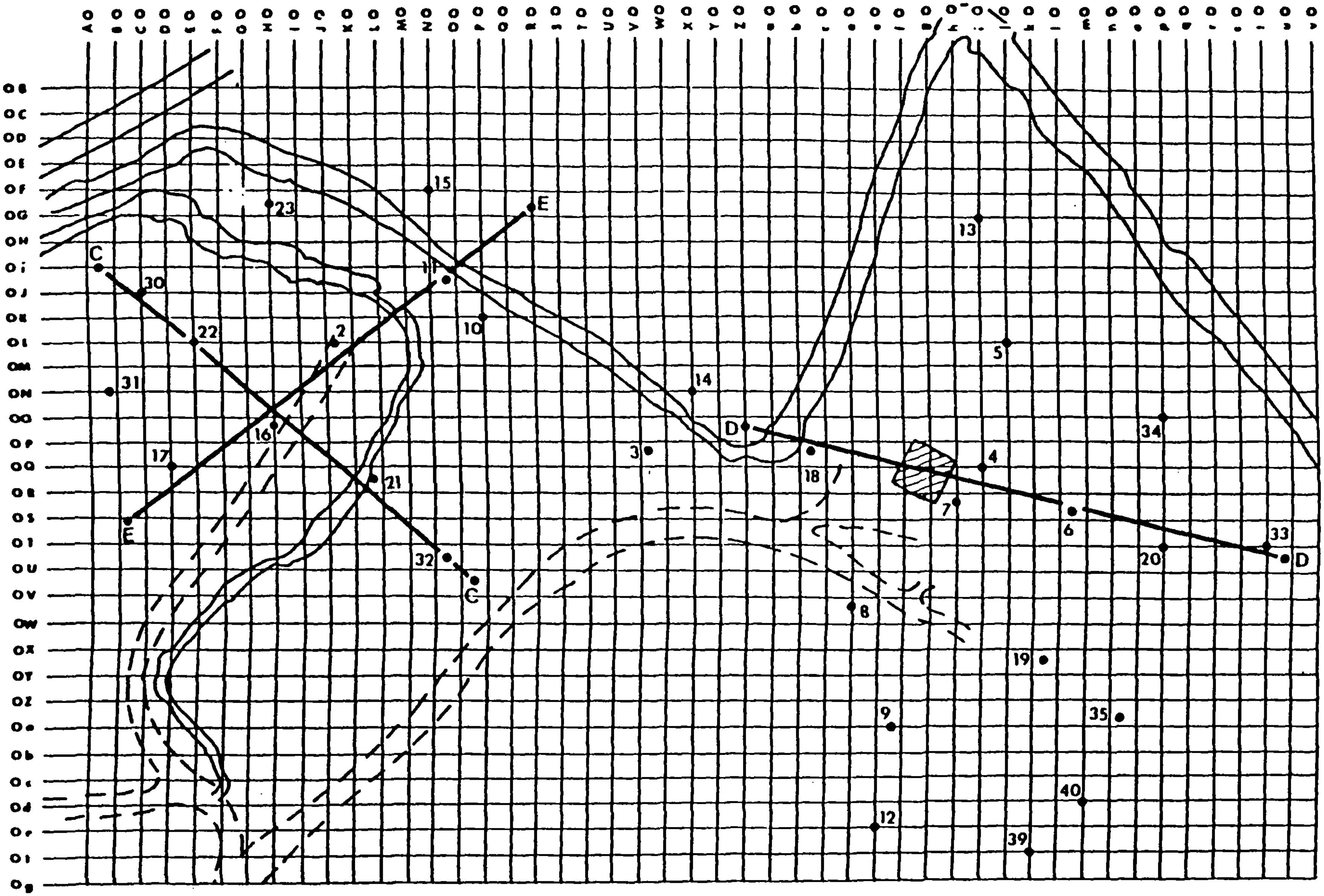


Figure 10. Location of auger holes, Area 2. Lines C-C, D-D, and E-E indicate cross sectional areas shown in Figures 17, 18, and 19.

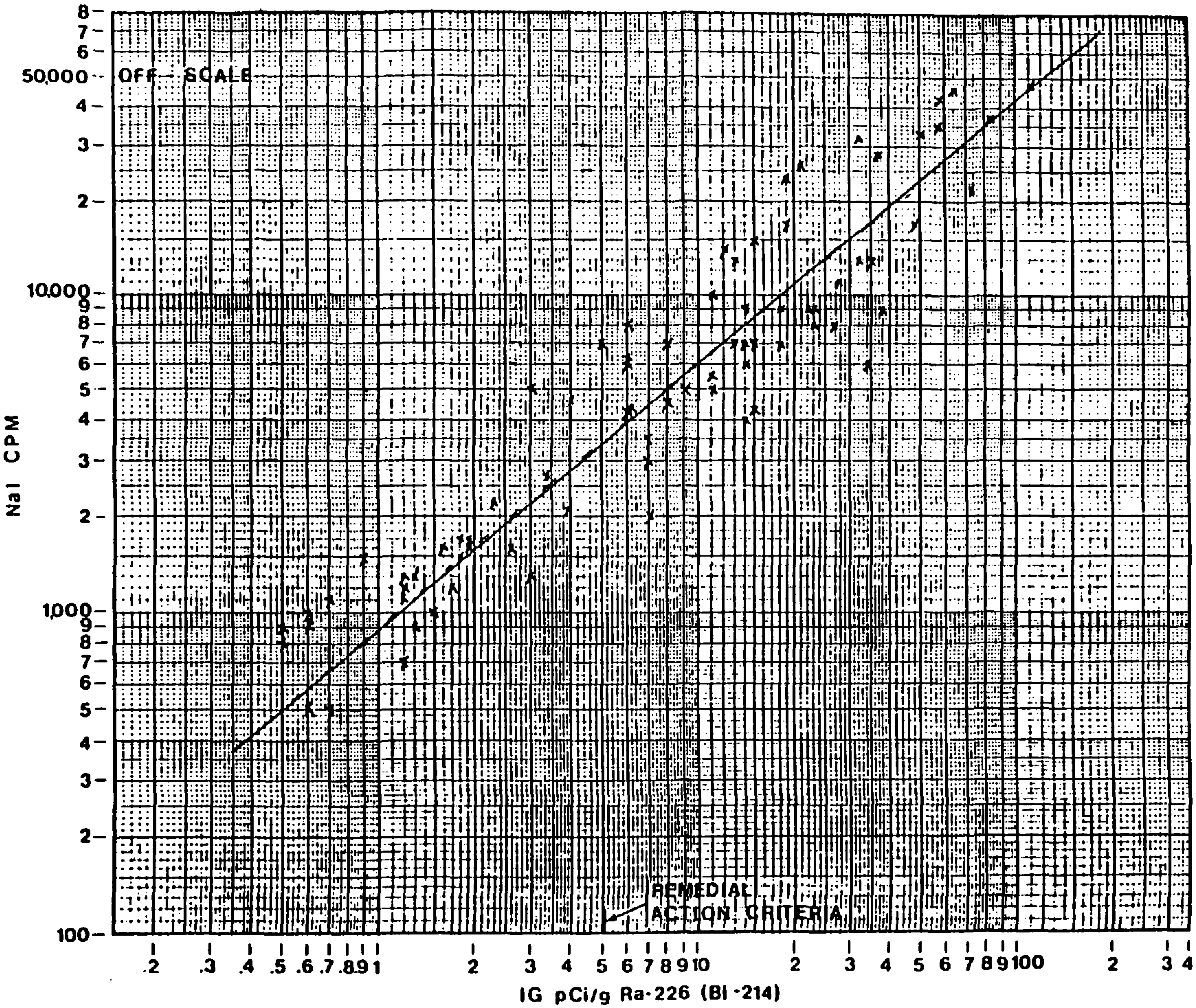


Figure 11. Auger hole NaI (Tl) count rate versus Ra-226 concentration, as determined by the I.G. in situ measurements. Data is from bore holes 16, 32, 22, 21, 31, 6, 19 and 20.

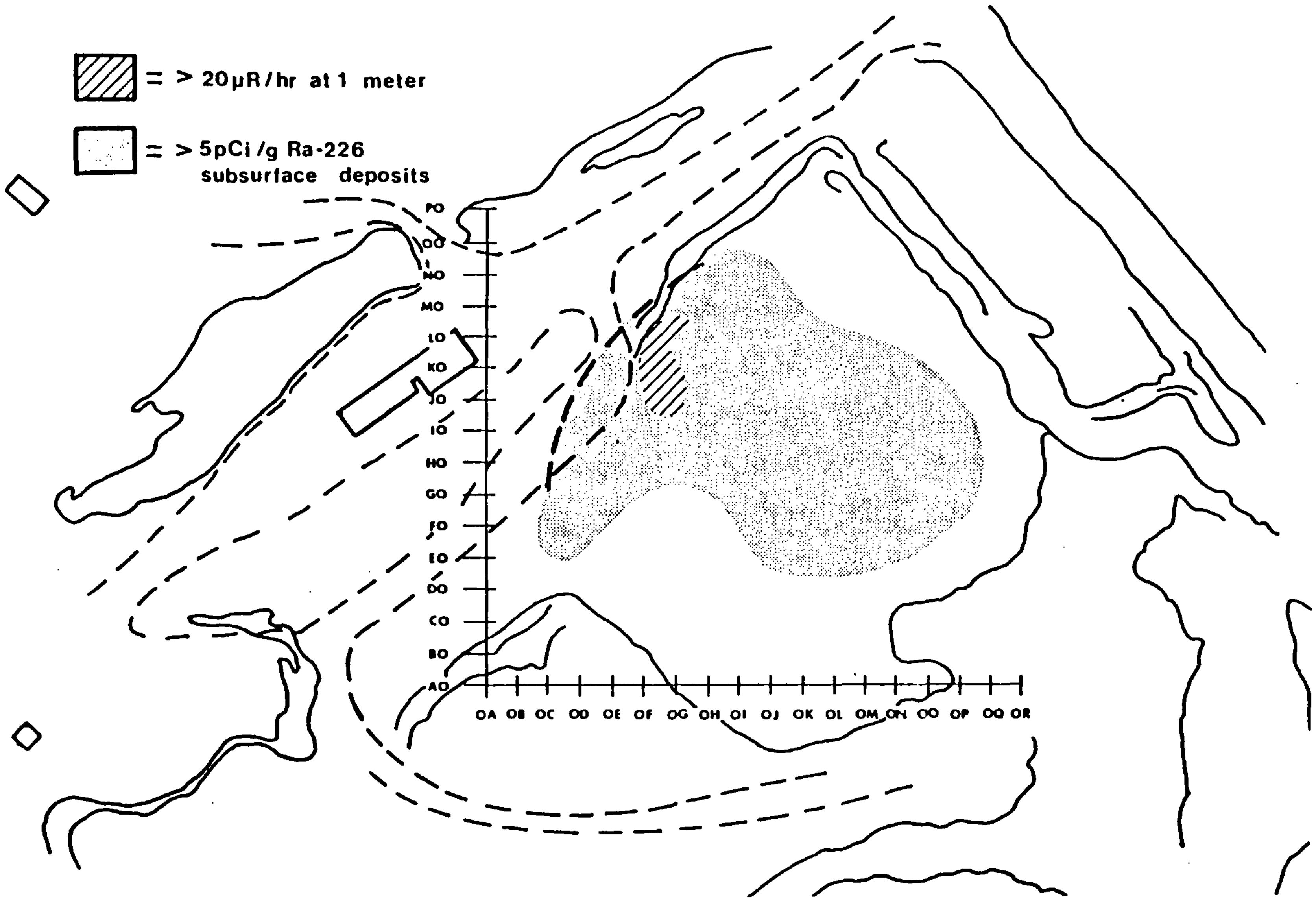


Figure 12. Location of subsurface contamination and surface radiation levels, Area 1. The shaded area shows a lateral contour for 5pCi/g Ra-226, regardless of depth. The cross hatched area shows the surface locations which exceed 20uR/hr at 1 meter.

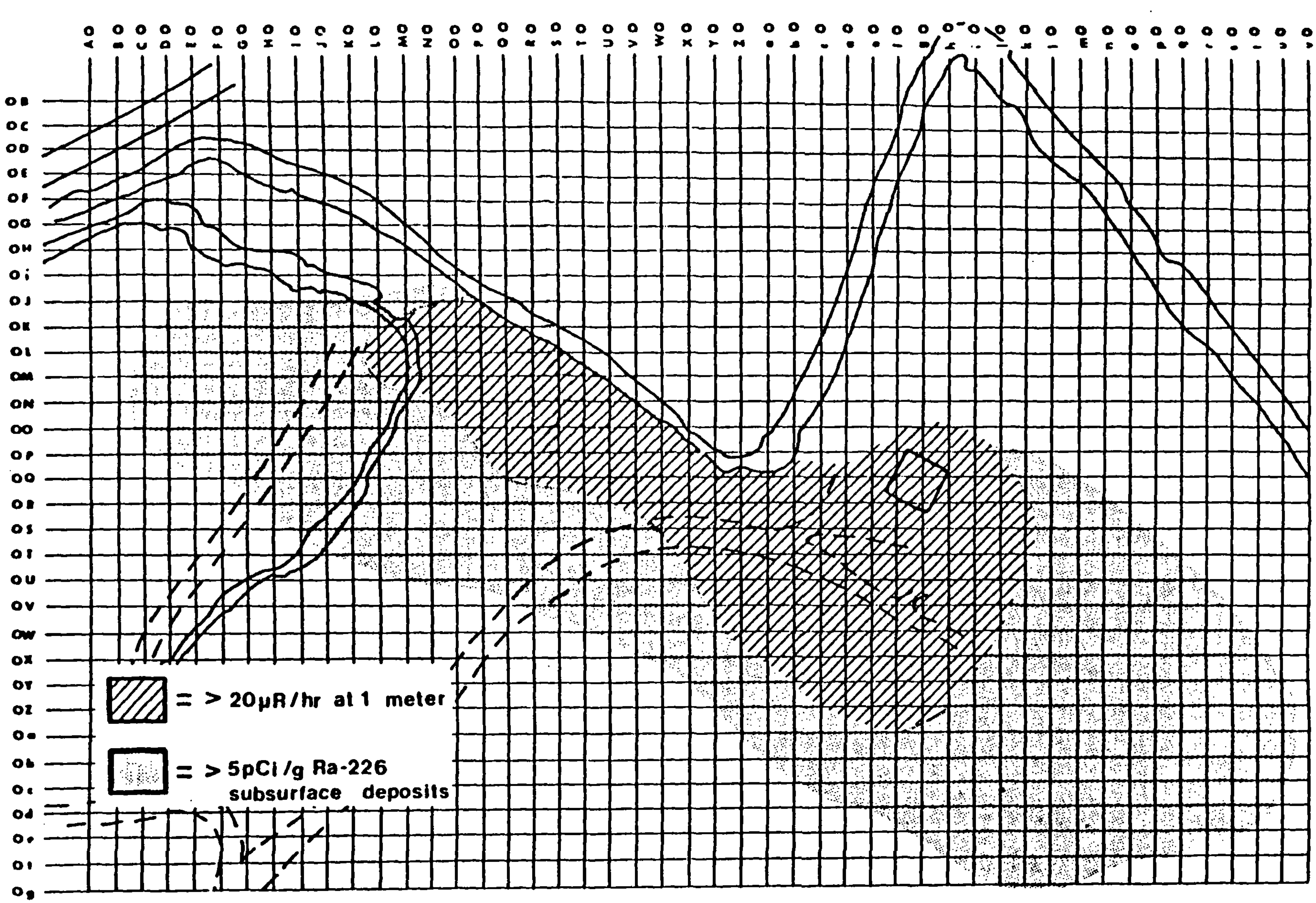


Figure 13. Location of subsurface contamination and surface radiation level, Area 2. The shaded area shows a lateral contour for 5pCi/g Ra-226, regardless of depth. The cross hatched area shows the surface location which exceeds 20uR/hr at 1 meter.

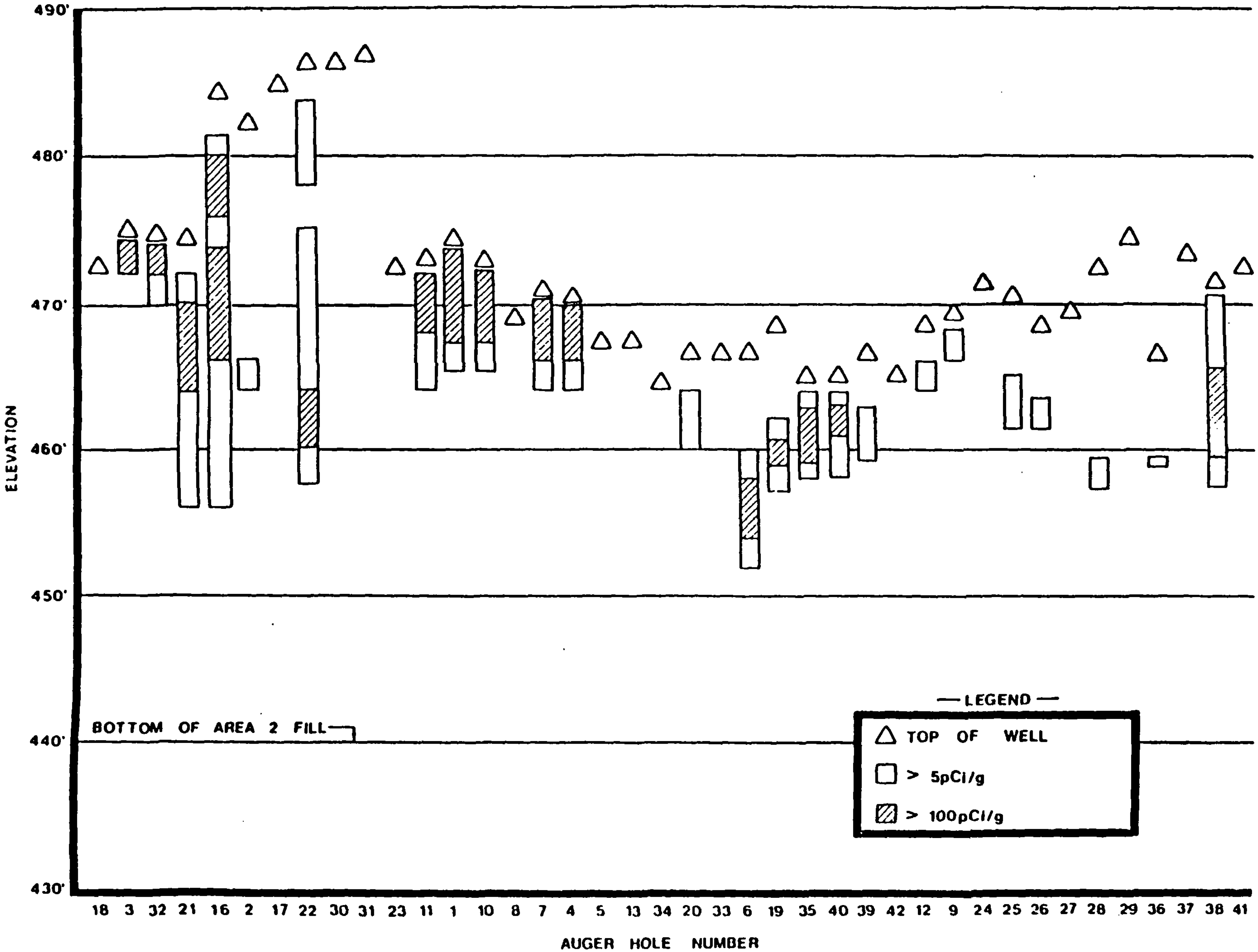


Figure 14. Auger hole elevations and location of contamination within each hole.

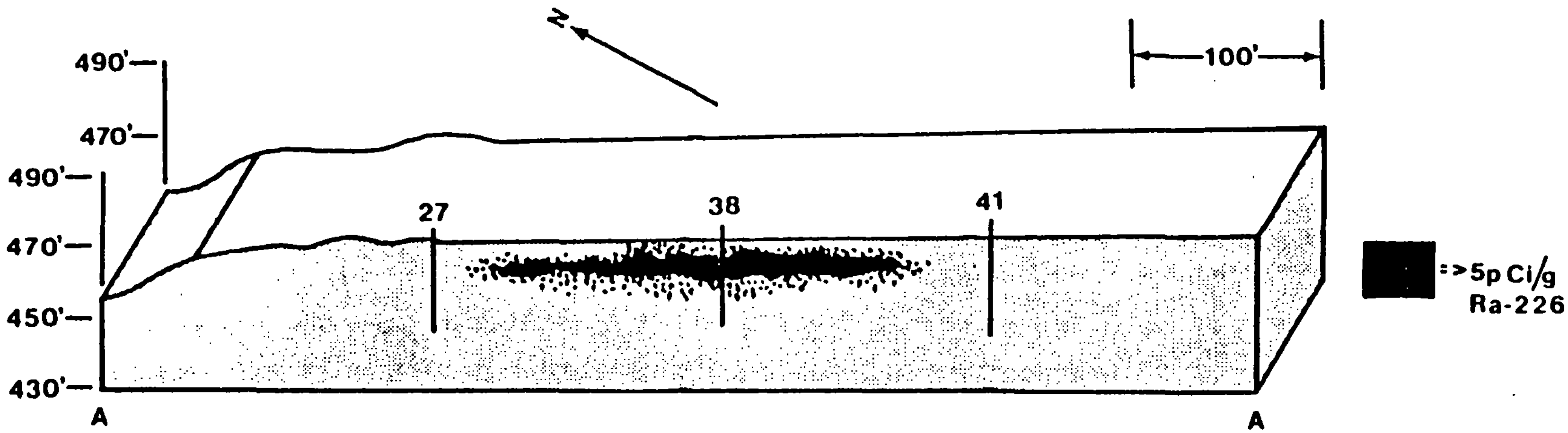


Figure 15. Cross section A-A (from Figure 9) showing subsurface deposits in Area 1. The blackened areas indicate the estimated extent of contamination exceeding 5pCi/g Ra-226, based on surface and auger hole measurements.

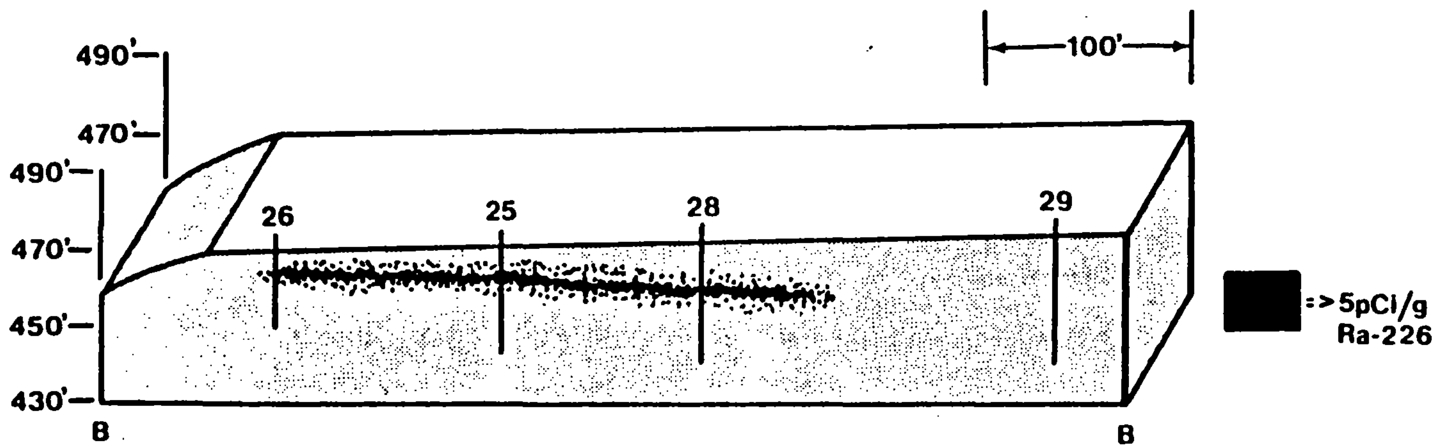


Figure 16. Cross section B-B (from Figure 9) showing subsurface deposits in Area 1. The blackened areas indicate the estimated extent of contamination exceeding 5pCi/g Ra-226, based on surface and auger hole measurements.

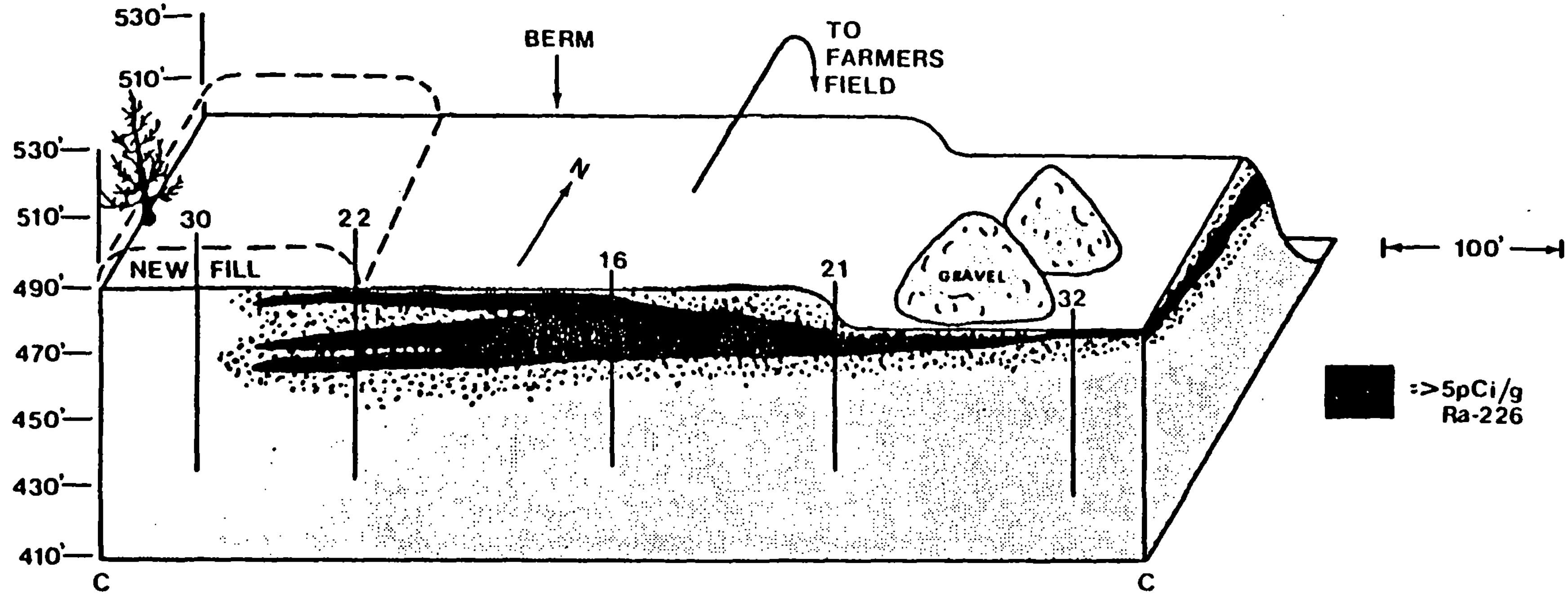


Figure 17. Cross section C-C (from Figure 10) showing subsurface deposits in Area 2. Blackened areas indicate the estimated location of contamination exceeding 5pCi/g Ra-226, based on surface and auger hole measurements.

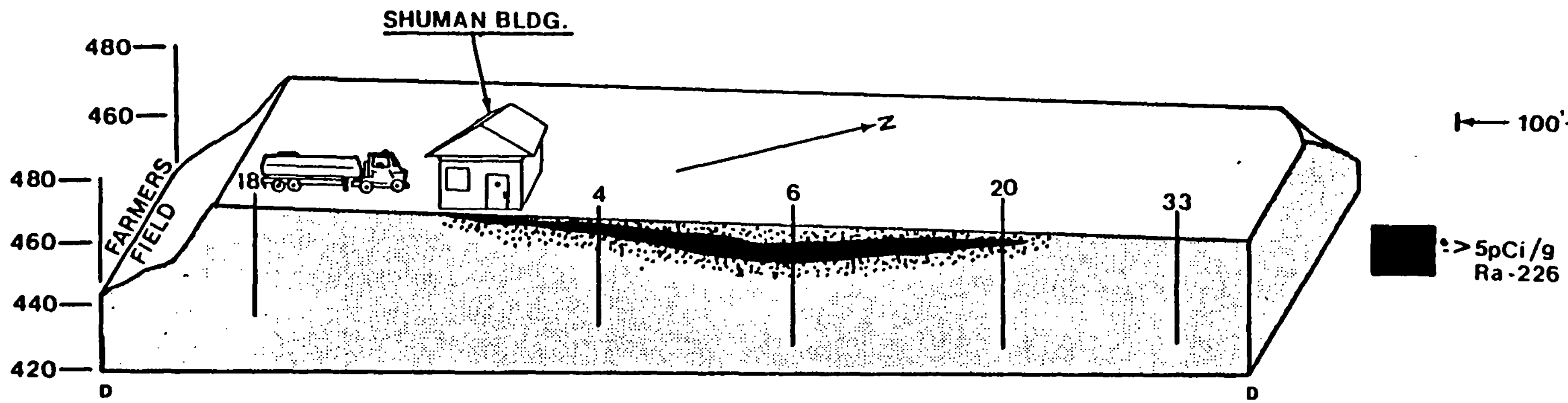


Figure 18. Cross section D-D (from Figure 10) showing subsurface deposits in Area 2. Blackened areas indicate the estimated location of contamination exceeding 5pCi/g Ra-226, based on surface and auger hole measurements.

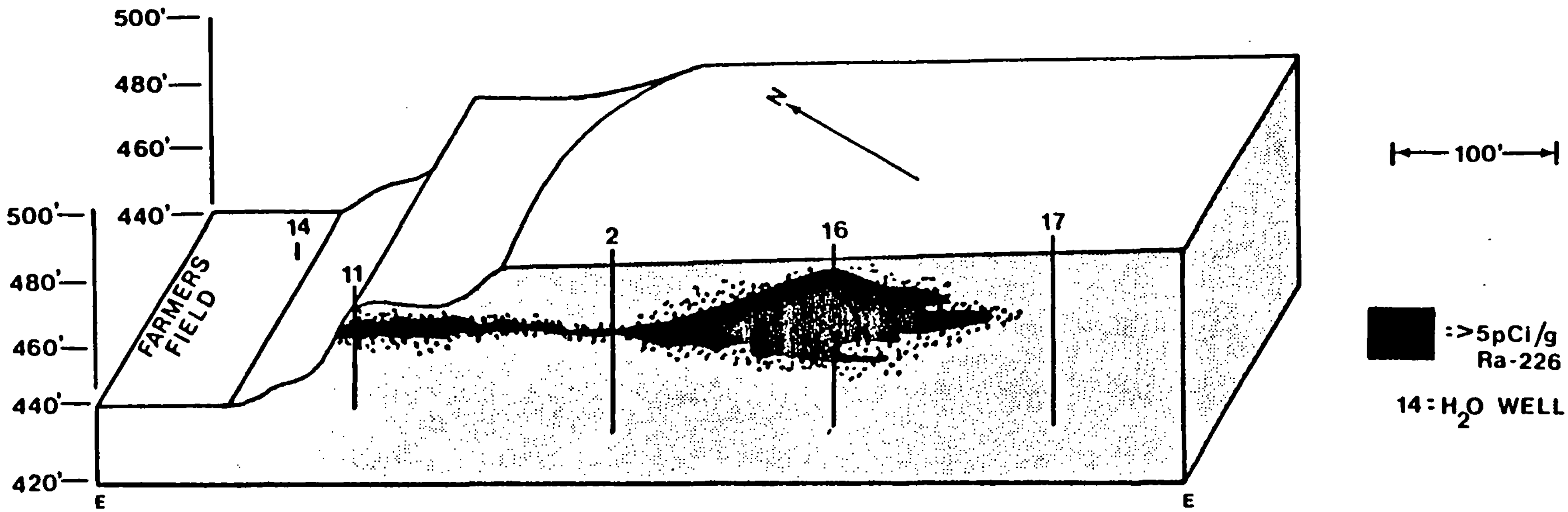


Figure 19. Cross section E-E (from Figure 10) showing subsurface deposits in Area 2. Blackened areas indicate the estimated location of contamination exceeding 5pCi/g Ra-226, based on surface and auger hole measurements.

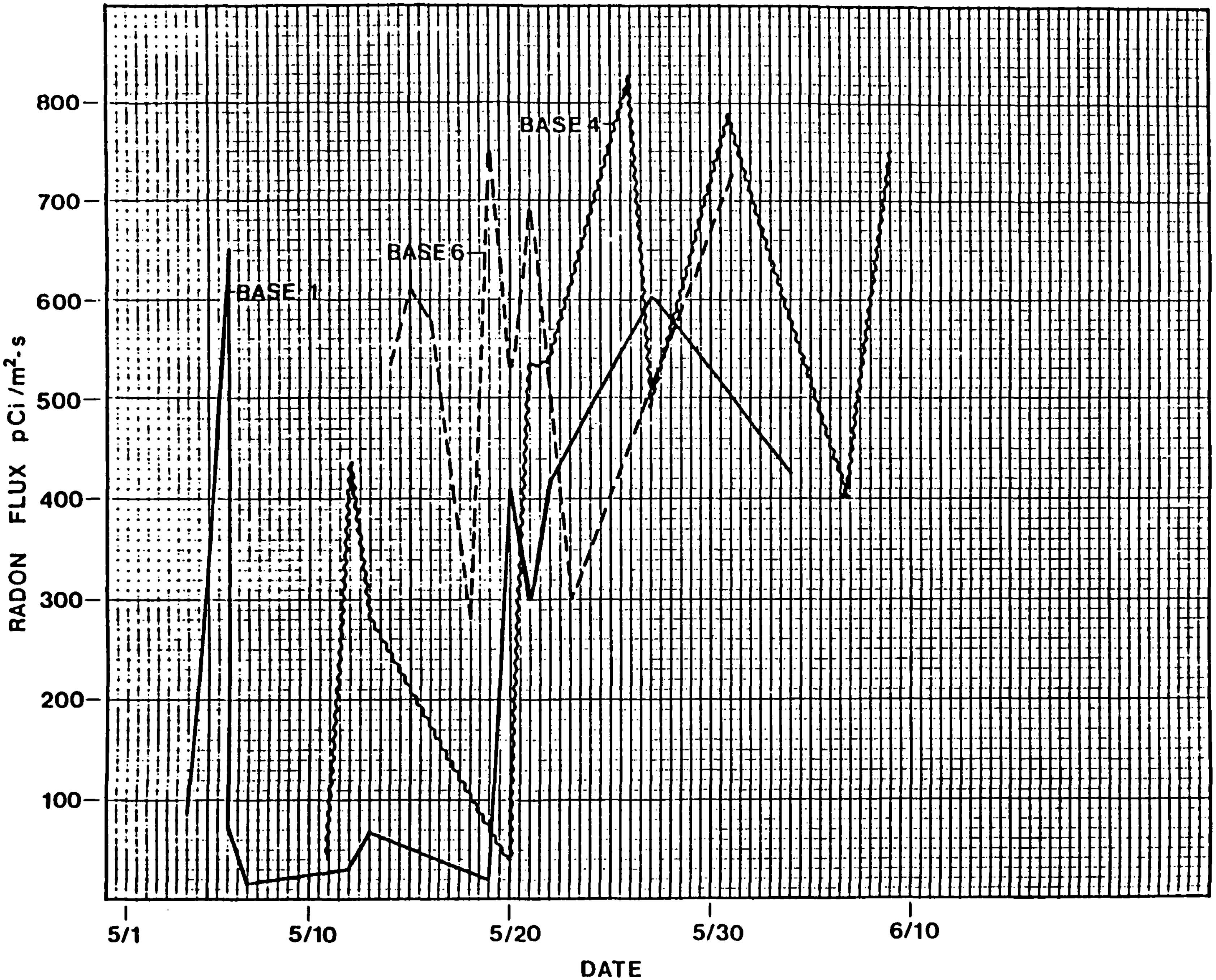


Figure 20. Radon-222 flux measurements at three locations in Area 2, for May, 1981.

Table 1

Gamma Radiation Levels and Beta-Gamma Count Rates at Grid Locations in Area 1

Grid Location	NaI Count Rate (c/min)	Exposure Rate (uR/hr)	Beta-Gamma Count Rate w/window (c/min)	Beta-Gamma Count Rate w/o window (c/min)
G00E	1000	10	30	40
H00E	900	9	60	50
I00E	1200	11	30	50
J00E	800	8	40	40
K00E	800	8	20	30
L00E	1200	11	20	30
M00E	800	8	40	40
N00E	760	7	40	30
P00H	1100	10	50	50
P00I	1200	11	40	30
Q00I	1000	10	50	50
P00J	1100	10	50	50
Q00J	1200	11	40	60
P00K	1100	10	40	30
Q00K	1200	11	30	50
C00F	900	9	40	50
D00F	900	9	30	40
E00F	1100	10	40	50
F00F	1200	11	30	40
G00F	900	9	40	40
H00F	1000	10	40	40
I00F	1200	11	40	40
J00F	2000	16	40	50
K00F	2700	20	50	50
L00F	2100	17	40	60
M00F	1500	12	60	60
N00F	1000	10	40	60
O00F	800	8	30	30
E00G	1100	10	20	30
F00G	1000	10	30	60
G00G	900	9	40	40
H00G	1000	10	20	40
I00G	1200	11	30	30
J00G	1000	10	30	40
K00G	1600	13	60	70
L00G	1300	11	40	50
M00G	2200	17	60	50
N00G	1300	11	30	40
O00G	-	-	50	40
E00H	1100	10	40	40
F00H	900	9	30	30
G00H	1100	10	30	50
H00H	1200	11	50	40
I00H	1000	10	40	50

Table 1, cont.

Grid Location	NaI Count Rate (c/min)	Exposure Rate (uR/hr)	Beta-Gamma Count Rate w/window (c/min)	Beta-Gamma Count Rate w/o window (c/min)
J00H	1000	10	50	40
K00H	1000	10	20	50
L00H	1100		20	50
M00H	1200	11	50	40
N00H	1500	12	50	80
O00H	-	-	40	40
E00I	1000	10	40	30
F00I	1000	10	30	40
G00I	800	8	30	30
H00I	1000	10	50	40
I00I	1100	10	30	60
J00I	1000	10	30	40
K00I	900	9	30	40
L00I	1000	10	30	40
M00I	900	9	40	40
N00I	1100	10	40	40
O00I	1100	10	30	50
E00J	1100	10	40	60
F00J	1200	11	30	40
G00J	1300	11	50	40
H00J	1200	11	50	50
I00J	1100	10	50	50
J00J	1000	10	30	30
K00J	1100	10	40	40
L00J	1000	10	40	50
M00J	1200	11	50	40
N00J	900	9	40	30
O00J	900	9	40	40
E00K	1000	10	50	50
F00K	900	9	40	50
G00K	1000	10	50	50
H00K	1100	10	50	60
I00K	800	8	50	50
J00K	900	9	40	40
K00K	900	9	40	40
L00K	1000	10	30	30
M00K	900	9	30	60
N00K	800	8	30	40
O00K	900	9	40	40
E00L	800	8	40	60
F00L	1000	10	50	50
G00L	900	9	40	40
H00L	900	9	40	60
I00L	1000	10	50	50
J00L	1000	10	50	60
K00L	1000	10	50	50
L00L	900	9	20	30

Table 1, cont.

Grid Location	NaI Count Rate (c/min)	Exposure Rate (UR/hr)	Beta-Gamma Count Rate w/window (c/min)	Beta-Gamma Count Rate w/o window (c/min)
M00L	1100	10	30	40
N00L	1000	10	50	40
O00L	900	9	20	40
F00M	900	7	30	40
G00M	1100	10	20	30
H00M	1000	10	30	40
I00M	1000	10	40	50
J00M	800	8	30	40
K00M	1000	10	40	40
L00M	1100	10	40	30
M00M	1000	10	30	30
N00M	1000	10	30	50
O00M	1000	10	30	40
F00N	900	9	30	50
G00N	1000	10	30	30
H00N	1100	10	30	30
I00N	900	9	40	30
J00N	900	9	40	50
K00N	800	8	40	60
L00N	900	9	40	30
M00N	1100	10	30	30
G00O	1000	10	40	60
H00O	1100	10	20	30
I00O	1000	10	20	30
J00O	1200	11	30	40
K00O	1000	10	40	50

Table 2

Gamma Radiation Levels and Beta-Gamma Count Rates at Grid Locations in Area 2

Grid Location	NaI Count Rate (c/min)	Exposure Rate (uR/hr)	Beta-Gamma Count Rate w/window (c/min)	Beta-Gamma Count Rate w/o window (c/min)
B00F	600	10	40	40
C00E	600	10	20	20
C00F	600	10	20	30
C00G	700	11	30	40
D00B	800	12	-	-
D00C	800	12	-	-
D00D	700	11	20	40
D00E	500	9	20	20
D00F	600	10	20	20
D00G	700	11	30	50
D00H	800	12	50	50
D00I	700	11	30	50
D00J	1100	15	30	40
E00A	500	9	-	-
E00B	800	12	-	-
E00C	800	12	-	-
E00D	700	11	-	-
E00E	700	11	30	30
E00F	500	9	20	20
E00G	500	9	30	30
E00H	800	12	30	40
E00I	700	11	30	30
E00J	900	13	30	30
F00A	800	12	-	-
F00B	900	13	-	-
F00C	800	12	40	40
F00D	900	13	30	30
F00E	1000	14	30	40
F00F	500	9	30	30
F00G	800	12	40	40
F00H	700	11	50	50
F00I	800	12	30	40
F00J	800	12	30	30
G00A	800	12	-	-
G00B	900	13	-	-
G00C	800	12	30	40
G00D	900	13	40	40
G00E	700	11	30	40
G00F	1000	14	30	40
G00G	1000	14	40	40
G00H	800	12	30	40
G00I	800	12	30	30
G00J	800	12	20	40
H00A	800	12	-	-

Table 2, cont.

Grid Location	NaI Count Rate (c/min)	Exposure Rate (uR/hr)	Beta-Gamma Count Rate w/window (c/min)	Beta-Gamma Count Rate w/o window (c/min)
H00B	800	12	-	-
H00C	800	12	30	30
H00D	1000	14	30	40
H00E	900	13	40	40
H00F	800	12	30	30
H00G	800	12	30	40
H00H	700	11	30	30
H00I	600	10	30	30
H00J	900	13	30	30
H00K	800	12	40	60
H00L	800	12	30	50
I00A	900	13	-	-
I00B	1000	14	-	-
I00C	1000	14	30	30
I00D	900	13	40	40
I00E	800	12	40	40
I00F	800	12	20	40
I00G	900	13	30	40
I00H	800	12	30	30
I00I	600	10	40	40
I00J	900	13	40	40
I00K	900	13	40	60
I00L	1100	15	40	80
J00A	900	13	-	-
J00B	800	12	-	-
J00C	900	13	-	-
J00D	1000	14	30	50
J00E	900	13	40	40
J00F	1200	16	30	40
J00G	1000	14	40	40
J00H	800	12	40	40
J00I	600	10	40	50
J00J	900	13	30	30
J00K	900	13	40	40
J00L	600	10	30	30
K00B	1000	14	-	-
K00C	1100	15	-	-
K00D	1200	16	40	50
K00E	1100	15	40	60
K00F	2000	23	30	40
K00G	1400	18	40	40
K00H	1000	14	40	40
K00I	1000	14	40	60
K00J	800	12	20	30
K00K	800	12	30	30
K00L	800	12	20	40
L00B	1000	14	-	-

Table 2, cont.

Grid Location	NaI Count Rate (c/min)	Exposure Rate (uR/hr)	Beta-Gamma Count Rate w/window (c/min)	Beta-Gamma Count Rate w/o window (c/min)
L00C	1100	15	-	-
L00D	1800	21	50	50
L00E	2600	27	40	40
L00F	2500	27	940	1000
* L00G	>50000	640	2100	2200
L00H	7000	55	70	120
L00I	2300	25	140	140
L00J	1300	17	40	80
L00K	2100	24	50	50
L00L	700	11	40	60
* L73E	>50000	400	-	-
M00B	1100	15	-	-
M00C	1500	19	-	-
M00D	1900	22	-	-
M00E	3700	35	80	80
M00F	8000	60	80	90
M00G	3600	35	50	50
M00H	5000	44	40	50
M00I	7000	55	80	90
M00J	1800	21	60	70
M00K	900	13	30	40
M00L	900	13	30	60
N00B	1200	16	-	-
N00C	1300	17	-	-
N00D	1600	20	-	-
N00E	2000	23	-	-
N00F	3300	32	-	-
N00G	1000	14	30	40
N00H	1000	14	40	50
N00I	47000	210	680	1020
N00J	2300	25	30	30
N00K	1000	14	40	50
N00L	900	13	30	50
O00C	1200	16	-	-
O00D	1100	15	-	-
O00E	1400	18	-	-
O00F	1400	18	50	60
O00G	900	13	40	40
O00H	1000	14	40	50
O00I	900	13	20	40
* O00J	>50000	840	4800	5200
O00K	1500	19	50	50
O00L	600	10	20	20
P00D	1100	15	-	-
P00E	1200	16	-	-
P00F	1000	14	40	60
P00G	1000	14	30	50

Table 2, cont.

Grid Location	NaI Count Rate (c/min)	Exposure Rate (uR/hr)	Beta-Gamma Count Rate w/window (c/min)	Beta-Gamma Count Rate w/o window (c/min)
P00H	1100	14	30	50
P00I	1000	14	50	60
P00J	1000	14	400	50
P00K	20000	115	240	300
P00L	3300	32	130	130
P00M	500	9	-	-
P00N	500	9	-	-
Q00E	1000	14	-	-
Q00F	900	13	-	-
Q00G	1000	14	30	40
Q00H	1000	14	30	40
Q00I	800	12	30	60
Q00J	800	12	30	40
Q00K	800	12	30	40
Q00L	1200	16	40	40
Q00M	1300	17	70	70
Q00N	600	10	20	40
R00F	1000	14	-	-
R00G	900	13	-	-
R00H	900	13	40	40
R00I	1000	14	30	30
R00J	800	12	40	40
R00K	900	13	40	40
R00L	1000	14	60	60
R00M	700	11	40	40
R00N	700	11	40	50
R00O	600	10	20	30
S00G	800	12	-	-
S00H	900	13	30	60
S00I	900	13	40	50
S00J	1000	14	50	60
S00K	900	13	40	40
S00L	1200	16	40	40
S00M	6000	48	80	80
S00N	500	9	30	30
S00O	2300	25	90	90
S00P	800	12	30	40
T00G	800	12	-	-
T00H	1100	15	-	-
T00I	1000	14	-	-
T00J	900	13	30	50
T00K	1000	14	30	40
T00L	1000	14	40	40
T00M	1600	20	60	70
T00N	2500	27	180	200
T00O	3100	31	70	70
T00P	16000	98	600	700

Table 2, cont.

Grid Location	NaI Count Rate (c/min)	Exposure Rate (uR/hr)	Beta-Gamma Count Rate w/window (c/min)	Beta-Gamma Count Rate w/o window (c/min)
T00Q	1500	19	30	40
T00R	500	9	30	40
T00S	700	11	-	-
U00H	700	11	-	-
U00I	900	13	-	-
U00J	800	12	-	-
U00K	700	11	40	50
U00L	900	13	50	50
U00M	1000	14	40	50
U00N	2800	29	100	140
U00O	3500	34	20	80
* U00P	>50000	450	1300	1500
U00Q	35000	170	400	720
U00R	1500	19	40	40
U00S	1000	14	-	-
V00J	800	12	-	-
V00K	900	13	40	40
V00L	1000	14	50	50
V00M	900	13	40	40
V00N	900	13	40	40
V00O	13000	85	500	500
V00P	4700	42	70	70
V00Q	12000	80	170	190
V00R	5000	44	100	100
V00S	700	11	-	-
W00K	800	12	-	-
W00L	800	12	30	30
W00M	800	12	30	30
W00N	900	13	40	50
W00O	1000	14	50	50
W00P	2100	120	600	800
W00Q	40000	190	900	1100
W00R	20000	115	140	170
W00S	1100	15	-	-
X00K	900	13	-	-
X00L	1100	15	-	-
X00M	1100	15	40	40
X00N	1000	14	40	40
X00O	1100	15	30	50
X00P	4000	37	120	160
X00Q	12000	80	300	400
* X00R	>50000	740	1900	2000
X00S	1500	19	-	-
Y00I	1000	14	-	-
Y00J	1300	17	-	-
Y00K	1600	20	-	-
Y00L	1600	20	-	-

Table 2, cont.

Grid Location	NaI Count Rate (c/min)	Exposure Rate (uR/hr)	Beta-Gamma Count Rate w/window (c/min)	Beta-Gamma Count Rate w/o window (c/min)
Y00M	1100	15	40	40
Y00N	3000	30	30	50
Y00O	1700	20	40	50
Y00P	2100	24	40	60
Y00Q	9000	66	200	280
Y00R	40000	190	1000	1400
Y00S	3600	35	-	-
Z00I	800	10	40	40
Z00J	1000	14	40	50
Z00K	1800	21	70	90
Z00L	3200	32	80	80
Z00M	3700	35	120	150
Z00N	5000	44	110	130
Z00O	3300	32	80	120
Z00P	1900	22	50	60
Z00Q	2400	26	50	60
Z00R	12000	80	300	380
Z00S	2600	27	-	-
a00I	900	13	40	50
a00J	900	13	20	40
a00K	1300	17	50	90
a00L	1800	21	60	80
a00M	1900	22	120	140
a00N	1200	16	90	100
a00O	1300	17	40	40
a00P	1000	14	20	30
a00Q	2200	24	60	60
a00R	2300	25	70	100
a00S	2600	27	-	-
b00I	900	13	-	-
b00J	900	13	-	-
b00P	800	12	40	50
b00Q	700	11	30	70
b00R	2400	26	60	90
b00S	2400	26	-	-
c00N	700	11	-	-
c00O	700	11	40	40
c00P	1000	14	50	50
c00Q	1300	17	60	80
c00R	1900	22	50	80
c00S	1800	21	-	-
d00O	1400	18	40	60
d00P			30	50
d00Q			30	60
d00R	2000	23	60	70
d00S	2000	23	-	-
d00T	900	13	-	-

Table 2, cont.

Grid Location	NaI Count Rate (c/min)	Exposure Rate (uR/hr)	Beta-Gamma Count R ate w/window (c/min)	Beta-Gamma Count Rate w/o window (c/min)
d00U	1800	21	-	-
d00V	2200	24	50	50
d00W	2500	27	100	100
d00X	700	11	30	30
e00L	600	10	70	70
e00O	1700	14	-	-
e95O	1000	14	-	-
e00P	-	-	70	100
e95Q	1000	14	40	40
e95R	1300	17	40	80
e95S	1800	21	-	-
e95T	2500	27	-	-
e95U	3500	34	-	-
e95V	3400	33	100	100
e95W	4000	37	120	140
e95X	3000	30	100	100
e95Y	1500	19	50	60
e95Z	1700	20	70	80
e00a	2300	25	90	100
f00K	600	10	60	60
f00L	700	11	50	80
f00O	1100	15	40	60
f57Q	3400	33	-	-
f00R	2700	28	60	60
f00S	2700	28	-	-
f00T	4500	41	-	-
f00U	6000	50	-	-
f00V	50000	230	1060	1080
f00W	6000	50	120	140
f00X	6000	50	100	100
f00Y	1500	19	50	60
f00Z	1000	14	40	40
f00a	1000	14	30	50
f00M	-	-	60	60
g00K	700	11	50	50
g00L	600	10	80	90
g00M	600	10	60	90
g00O	2000	23	80	110
g00P	2000	23	50	90
g00Q	3300	32	70	100
g00R	21000	120	300	420
g00S	8000	62	-	-
g00T	6000	50	-	-
g00U	15000	95	-	-
g00V	11000	77	180	260
g00W	7000	56	110	140
g00X	2500	27	50	60

Table 2, cont.

	Grid Location	NaI Count Rate (c/min)	Exposure Rate (uR/hr)	Beta-Gamma Count Rate w/window (c/min)	Beta-Gamma Count Rate w/o window (c/min)
	g00Y	2200	24	90	120
	g00Z	1500	19	50	70
	g00a	1000	14	30	30
	h00K	700	11	30	30
	h00L	800	12	70	70
	h00M	900	13	70	80
	h00N	1000	14	-	-
	h00O	3100	31	70	70
	h00P	17000	105	180	280
*	h00Q	>50000	1050	4200	4200
	h00R	27000	140	560	660
	h00S	45000	205	900	1080
	h00T	4000	37	150	150
	h00U	6500	52	170	190
	h00V	10000	72	240	250
	h00W	3800	36	200	300
	h00X	1000	14	60	80
	h00Y	1800	21	50	50
	h00Z	700	11	20	30
	h00a	700	11	40	40
	h72P	-	-	8000	9400
	i00K	800	12	40	50
	i00L	900	13	60	60
	i00M	1700	20	90	110
	i00N	8000	60	110	110
	i00O	36000	175	1000	1100
*	i00P	>50000	1600	7200	8400
*	i00Q	>50000	1170	2800	3600
	i00R	30000	155	900	1120
	i00S	800	60	180	300
	i00T	1600	20	40	40
	i00U	3000	30	130	180
	i00V	2200	24	-	-
	i00W	1400	18	40	60
	i00X	1000	14	40	60
	i00Y	1500	19	70	70
	j00K	800	12	60	60
	j00L	900	13	60	80
	j00M	2000	23	90	90
	j00N	6000	49	130	160
	j00O	10000	70	130	180
	j00P	20000	115	400	420
	j00Q	16000	98	410	500
	j00R	21000	120	560	700
	j00S	1900	22	70	90
	j00T	1200	16	50	60
	j00U	1000	14	60	60

Table 2, cont.

Grid Location	NaI Count Rate (c/min)	Exposure Rate (uR/hr)	Beta-Gamma Count Rate w/window (c/min)	Beta-Gamma Count Rate w/o window (c/min)
j00V	1800	21	70	70
j00W	1200	16	70	80
j00X	1000	14	50	50
j00Y	1100	15	60	60
k00L	1000	14	70	70
k00M	1100	15	90	110
k00N	1000	14	60	90
k00O	1000	14	70	90
k00P	1100	15	80	110
k00Q	1400	18	40	40
k00R	7500	58	140	180
k00S	1100	15	50	50
k00T	1100	15	30	50
k00U	1700	20	60	60
k00V	1700	20	50	60
k00W	700	11	40	40
k00X	700	11	40	50
k00Y	1000	14	40	50
l00L	900	13	70	70
l00M	900	13	70	80
l00N	800	12	70	70
l00O	900	13	80	90
l00P	700	11	60	70
l00Q	900	13	50	50
l00R	800	12	40	40
l00S	1200	16	40	50
l00T	1200	16	60	70
l00U	1100	15	60	80
l00V	900	13	30	40
m00O	800	12	80	80
m00P	700	11	60	60
m00Q	700	11	40	40
m00R	900	13	30	50
m00S	1000	14	40	40

* Reading >50,000 on NaI, reading was made with end window GM tube with beta shield.

Table 3

Surface Soil Sample Radionuclide Concentrations
(pCi/g), by Gamma Analysis

Location	Sample	K-40	U-238	Ra-226	Pb-214	Bi-214	Ra-223	Rn-219	Pb-211	Pb-212
G00C	Area 2, Berm	2.4E1	-----	2.1E0	2.1E0	2.1E0	-----	-----	-----	-----
i00Q	Area 2, Near Shuman Bld	-----	3.0E2	8.6E2	9.6E2	7.6E2	1.6E2	3.1E2	3.6E2	-----
Z00N	Area 2, Road Surface	-----	4.4E1	6.0E2	6.6E2	5.4E2	2.0E1	2.0E1	-----	-----
O00J	Area 2, Near Berm	-----	5.7E2	2.3E3	2.5E3	2.0E3	6.0E2	7.8E2	9.6E2	-----
O00G	Area 2, Near Berm	2.1E1	-----	1.0E1	1.1E1	9.6E0	-----	-----	-----	-----
N00I	Area 2, Near Berm	-----	5.5E2	2.0E3	2.0E3	2.1E3	4.9E2	7.9E2	8.9E2	-----
M00E	Area 2, Berm	1.3E1	-----	3.9E1	4.2E1	3.6E0	-----	-----	-----	-----
F00C	Area 2, Berm	1.4E1	-----	1.7E0	1.9E0	1.5E0	-----	-----	-----	-----
S00K	Area 2, Near Gravel Pile	3.2E1	-----	3.9E0	3.9E0	-----	-----	-----	-----	-----
i00P	Area 2, Near Shuman Bldg	-----	8.3E2	4.0E3	4.4E3	3.6E3	9.6E2	9.6E2	1.5E3	-----
S00L	Area 2, Near Gravel Pile	2.8E1	-----	2.5E0	2.4E0	2.6E0	-----	-----	-----	-----
h00Q	Area 2, Near Shuman Bldg	-----	1.5E2	3.0E1	3.4E2	2.6E2	1.7E2	1.9E2	1.5E2	-----
SPEC	Off-site Bkg Earth City	2.6E1	-----	2.5E0	2.5E0	2.5E0	-----	-----	-----	-----
i00P	Area 2, Duplicate	-----	6.4E2	2.7E3	3.0E3	2.4E3	2.3E3	1.2E3	1.1E3	-----
SPEC	Off-site Bkg Earth City	1.9E1	-----	2.7E0	2.5E0	2.9E0	-----	-----	-----	-----
Z00O	Area 2, Road Surface	-----	2.8E1	5.2E1	5.7E1	4.8E1	3.1E1	3.1E1	3.4E1	-----
SPEC	Leachate Treatment Sludge	-----	-----	6.9E0	7.9E0	5.9E0	-----	-----	-----	-----
N00I	Area 2, Near Berm	-----	7.6E2	7.1E3	1.0E4	4.2E3	2.2E3	2.0E3	1.8E3	-----
SPEC	Area 1, Base 6 Near Road	-----	6.5E2	2.4E3	2.7E3	2.1E3	1.6E3	1.4E3	1.0E3	-----
P00I	Area 2, Near Berm	1.7E1	1.0E0	7.0E0	7.3E0	6.8E0	-----	-----	-----	-----
SPEC	Area 1, Base 7 Near Road	-----	3.7E1	2.7E2	3.4E2	2.1E2	2.9E1	-----	5.8E1	2.2E0
SPEC	Leachate Treatment Sludge	-----	-----	2.3E0	-----	2.3E0	-----	-----	-----	-----
SPEC	Area 1, Base 6 Near Road	-----	6.5E2	2.7E3	3.1E3	2.5E3	1.2E3	1.1E3	9.5E2	-----
SPEC	Area 1, Base 5 Brown Soil	-----	3.9E2	1.1E3	1.6E3	8.2E2	2.8E2	3.8E2	3.7E2	-----
SPEC	Area 1, Base 5 Black Soil	-----	3.1E2	6.8E2	7.8E2	5.8E2	3.1E2	3.2E2	3.2E2	-----
SPEC	Off-site Bkg Taussig Road	3.2E1	-----	2.5E0	2.4E0	2.6E0	-----	-----	-----	2.4E0
SPEC	Area 1, Base 5 White Soil	-----	2.1E3	2.1E4	2.3E4	1.9E4	5.3E3	5.3E3	5.0E3	-----
i00P	Area 2, Duplicate	-----	6.2E2	3.5E3	3.7E3	3.2E3	1.3E3	1.3E3	1.7E3	-----
J00G	Area 1, Hot Spot	-----	3.4E1	9.7E1	1.1E2	8.3E1	4.3E1	4.3E1	4.6E1	-----
M00H	Area 1, Low Level Area	2.2E1	-----	2.7E0	2.6E0	2.8E0	-----	-----	-----	3.0E0
K00F	Area 1	2.0E1	-----	3.7E0	3.6E0	3.8E0	-----	-----	-----	2.1E0
SPEC	Area 1, East Berm	2.4E1	-----	2.6E0	2.2E0	2.9E0	-----	-----	-----	-----

Table 3 cont.

Location	Sample	K-40	U-238	Ra-226	Pb-214	Bi-214	Ra-223	Rn-219	Pb-211	Pb-212
I00L	Area 1	-----	-----	2.9E0	3.2E0	2.6E0	-----	-----	-----	2.3E0
SPEC	Area 1, East Berm	1.8E1	-----	2.4E0	2.2E0	2.6E0	-----	-----	-----	-----
P00H	Area 1, Near Road	3.0E1	-----	4.3E0	5.2E0	3.3E0	-----	-----	-----	1.8E0
N62H	Area 1	2.5E1	-----	4.1E0	3.4E0	4.7E0	-----	-----	-----	3.0E0
O11J	Area 1, Near Berm	-----	9.4E2	4.2E3	4.6E3	3.9E3	2.0E3	2.1E3	2.1E3	-----
L73E	Area 2, Side of Hill	-----	3.8E2	1.1E3	1.2E3	1.0E3	4.5E2	4.6E2	3.8E2	-----
K00F	Area 1	3.9E1	-----	4.4E0	5.2E0	3.5E0	-----	-----	-----	-----
N62H	Area 1, Fill	2.7E1	-----	3.1E0	3.1E0	3.1E0	-----	-----	-----	1.3E0
N00F	Area 1, Fill	-----	-----	2.6E0	3.0E0	2.1E0	-----	-----	-----	2.6E0
J00G	Area 1, Fill	-----	-----	2.3E0	3.5E0	1.1E0	-----	-----	-----	1.5E0
K66E	Area 1, Near Parking Lot	-----	-----	1.5E1	1.7E1	1.3E1	-----	-----	-----	-----
I00I	Area 1, Fill	3.1E1	-----	3.8E0	-----	3.8E0	-----	-----	-----	1.6E0

Soil Radiochemical Analysis

Table 4

Bi-214 from Gamma Spectroscopy

Sample	Activity pCi/gm		
	U-238	Th-230	Bi-214
	(All +/- 25%)	(All +/- 25%)	(All +/- 25%)
Area 1 Surface (1980)	3.8	82	2.1
Area 1 Surface (1980)	12	597	25
Area 1 Borehole 1 (1980)	21	188	44
Area 2 Surface (1980)	175	6,095	1,488
Area 2 Surface (1980)	18	338	9.4
Base 5 Surface (1981)	101	178,000	19,000
Base 6 Surface (1981)	54	46,100	2,600
Borehole 11 (1981)	82	29,200	1,800
N11J Surface (1981)	127	27,200	2,000
O11J Surface (1981)	1.0	52,000	3,900

Auger Hole NaI Counts and IG Analysis

Table 5

Borehole #1 — Radionuclide Concentrations [pCi/g]

Depth	Gross NaI	Ra-226	Pb-214	Bi-214	U-238	Ra-223	K-40	Pb-211	Pb-212
00	>50,000	1.6E1	1.6E2	1.7E2	1.6E2	------	------	------	-------
01	>50,000	7.5E2	6.5E2	9E2	1.7E2	------	------	1.4E2	-------
02	>50,000	2.2E4	2.4E4	1.9E4	------	------	------	4.2E3	-------
03	>50,000	4.0E3	3.0E3	4.8E3	------	1.1E3	------	2.1E2	-------
04	>50,000	1.3E3	1.2E3	1.4E3	9.3E1	------	------	------	-------
05	20,000	2.4E1	-------	2.4E1	------	------	8.0E0	------	-------
06	4,500	3.9E0	3.5E0	4.3E0	------	------	1.1E1	------	-------
08	2,200	2.3E0	2.3E0	2.2E0	------	------	1.4E1	------	7.2E-1
10	2,000	2.3E0	2.4E0	2.2E0	------	------	1.3E1	------	8.3E-1
12	1,500	1.9E0	2.2E0	1.6E0	------	------	1.3E1	------	-------
14	1,300	1.8E0	1.9E0	1.7E0	------	------	9.7E0	------	6.3E-1
16	800	1.3E0	1.2E0	1.3E0	------	------	1.0E1	------	3.9E-1
18	800	1.2E0	1.6E0	8.0E-1	------	------	3.3E0	------	3.0E-1
20	800	8.1E-1	7.4E-2	8.7E-1	------	------	1.0E1	------	3.2E-1
22	500	6.5E-1	4.0E-1	9.0E-1	------	------	2.5E0	------	-------
24	150	2.5E-1	2.8E-1	2.1E-1	------	------	1.5E0	------	-------
26	1,000	6.3E-1	7.2E-1	5.4E-1	------	------	6.3E0	------	3.1E-1
28	1,300	8.7E-1	8.4E-1	8.9E-1	------	------	1.2E1	------	5.7E-1
30	500	4.3E-1	-------	4.3E-1	------	------	3.0E0	------	2.1E-1
32	700	1.3E0	1.E0	1.2E0	------	------	6.1E0	------	4.2E-1
34	1,400	2.4E0	2.5E0	2.2E0	------	------	6.1E0	------	5.4E-1
36	1,800	1.4E0	1.5E0	1.2E0	------	------	1.2E1	------	-------

Borehole #3 — Radionuclide Concentrations [pCi/g]

Depth	Gross NaI	Ra-226	Pb-214	Bi-214	U-238	Ra-223	K-40	Pb-211	Pb-212
00	>50,000	8.4E2	7.8E2	8.4E2	------	------	------	6.4E1	-------
01	>50,000	1.5E4	1.3E4	1.9E4	1.4E3	------	------	------	-------
02	>50,000	7.0E3	5.3E3	8.7E3	------	------	------	------	-------
03	1,400	2.3E1	1.4E1	3.2E1	------	------	1.2E1	------	-------
05	2,300	6.2E0	5.8E0	6.6E0	------	------	8.9E0	------	-------
07	3,000	4.7E0	4.9E0	4.4E0	------	------	6.9E0	------	-------
09	1,800	3.5E0	4.2E0	2.8E0	------	3.6E0	8.2E0	------	-------
11	1,000	1.8E0	2.1E0	1.5E0	------	------	4.1E0	------	-------
13	600	1.7E0	1.4E0	2.0E0	------	------	------	------	-------
15	1,800	4.5E0	4.6E0	4.4E0	------	4.7E0	4.2E0	------	-------

Table 5, cont.

Borehole #3, cont. Radionuclide Concentrations [pCi/g]

Depth	Gross NaI	Ra-226	Pb-214	Bi-214	U-238	Ra-223	K-40	Pb-211	Pb-212
17	1,000	9.0E-1	1.1E0	7.3E-1	------	------	6.4E0	------	4.4E-1
19	500	2.9E-1	3.E-1	2.1E-1	------	------	2.2E0	------	-------
21	500	5.0E-1	7.E-1	2.2E-1	------	------	2.0E0	------	-------
23	700	1.0E0	1.1E0	8.7E-1	------	------	6.3E0	------	5.3E-1
25	600	3.3E-1	3.7E-1	2.9E-1	------	------	------	------	-------
27	900	9.7E-1	1.1E0	8.4E-1	------	------	6.5E0	------	5.4E-1
29	1,000	5.4E-1	4.8E-1	6.0E-1	------	------	7.6E0	------	-------

Borehole #4 Radionuclide Concentrations [pCi/g]

Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
00	>50,000	------	1.5E2	1.7E2	1.3E2	9.5E1	------	9.9E1	-------
01	>50,000	5.3E2	2.1E3	1.7E3	2.5E3	9.8E2	------	1.2E3	-------
02	>50,000	------	1.2E2	9.E1	1.5E2	------	3.6E0	------	-------
03	14,000	------	2.8E0	2.1E0	3.5E0	------	3.8E0	------	-------
04	2,900	------	1.6E0	1.6E0	1.6E0	------	3.6E0	------	-------
06	1,100	------	1.4E0	1.5E0	1.2E0	8.6E-1	4.1E0	------	-------
08	1,200	------	1.7E0	1.9E0	1.5E0	9.0E-1	7.1E0	------	-------
10	1,500	------	2.7E	2.8E0	2.5E0	8.3E-1	9.3E0	3.8E0	-------
12	2,600	------	-------	------	------	------	------	------	-------
14	1,500	------	1.7E0	1.6E0	1.7E0	7.0E-1	7.0E0	------	-------
16	1,400	------	1.0E0	1.2E0	8.4E-1	------	------	------	-------
18	1,100	------	8.0E-1	8.E1-1	8.0E-1	------	8.5E0	------	3.8E-1
20	800	------	7.6E-1	8.6E-1	6.6E-1	------	------	------	-------
22	1,100	------	1.1E0	.1E0	1.1E0	------	7.7E0	------	4.1E1
24	1,200	------	7.5E-1	8.1E-1	7.0E-1	------	1.6E-1	------	3.5E-1
26	1,000	------	4.8E-1	4.2E-1	5.4E-1	------	6.6E0	------	3.0E-1
28	700	------	7.1E-1	7.2E-1	7.0E-1	------	------	------	-------
30	1,300	------	8.7E-1	9.9E-1	7.5E-1	------	1.4E1	------	6.4E-1
32	1,500	------	9.5E-1	9.5E-1	9.5E-1	------	1.5E1	------	-------
34	1,700	------	1.9E0	2.2E0	1.6E0	------	1.3E1	------	5.5E-1

Borehole #5 Radionuclide Concentrations [pCi/g]

Depth	Gross NaI	Ra-226	Pb-214	Bi-214	U-238	Ra-223	K-40	Pb-211	Pb-212
00	1,800	1.8E0	-------	1.7E0	------	------	6.3E0	------	-------
02	1,500	2.5E0	2.9E0	2.0E0	------	3.4E0	4.0E0	------	-------
04	2,700	3.4E0	3.7E0	3.1E0	------	------	4.4E0	------	-------
06	1,600	1.7E0	1.5E0	1.9E0	------	------	1.1E1	------	9.2E-1

Table 5, cont.

Borehole #5, cont. — Radionuclide Concentrations [pCi/g]

Depth	Gross NaI	Ra-226	Pb-214	Bi-214	U-238	Ra-223	K-40	Pb-211	Pb-212
08	1,000	1.3E0	1.6E0	1.0E0	------	------	1.0E1	------	-------
10	3,000	4.3E0	4.3E0	4.3E0	------	------	4.7E0	------	2.0E0
12	1,700	2.1E0	1.9E0	2.3E0	------	------	2.9E0	2.2E0	-------
14	1,000	1.8E0	1.3E0	2.3E0	------	------	3.0E0	------	-------
16	700	8.3E-1	6.0E-1	1.1E0	------	------	2.1E0	------	-------
18	500	8.9E-1	6.8E-1	1.1E0	------	------	2.1E0	------	-------

Borehole #6 — Radionuclide Concentrations [pCi/g]

Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
00	2,000	------	7.3E0	8.3E0	6.4E0	7.4E0	9.4E0	1.2E1	-------
02	2,000	------	-------	------	------	------	------	------	-------
04	3,200	2.2E1	2.5E0	3.0E1	.0E1	2.0E1	------	1.9E1	-------
06	3,500	------	2.1E0	2.2E1	2.1E1	1.9E1	------	1.6E1	-------
07	6,000	1.6E1	1.5E1	1.7E1	1.3E1	8.1E0	------	------	-------
08	26,000	3.9E1	2.1E1	2.2E1	2.1E1	1.8E1	------	1.5E1	-------
09	>50,000	------	4.0E1	4.1E1	4.0E1	3.6E1	------	------	-------
10	43,000	------	5.8E1	5.3E1	6.3E1	4.1E1	------	4.01E	-------
11	>50,000	------	3.6E2	2.8E2	2.3E2	2.0E2	------	1.7E2	-------
12	16,000	4.4E1	9.9E1	9.1E1	1.1E2	3.9E1	------	5.6E1	-------
13	2,600	------	6.4E0	7.2E0	5.5E0	4.4E0	8.5E0	------	-------
15	1,100	------	-------	------	------	------	------	------	-------

Borehole #8 — Radionuclide Concentrations [pCi/g]

Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
00	2,000	------	3.7E0	4.0E0	3.4E0	1.5E0	5.2E0	------	4.9E-1
02	1,500	------	1.4E0	1.5E0	1.3E0	------	6.5E0	------	-------
04	1,100	------	1.1E0	1.2E0	9.2E-1	------	4.7E0	------	-------
06	1,400	------	1.1E0	1.1E0	1.1E0	------	1.1E1	------	8.3E-1
08	1,400	------	1.1E0	1.1E0	1.1E0	------	1.1E1	------	8.E-1
10	1,500	------	1.2E0	1.2E0	1.1E0	------	1.1E1	------	-------
12	1,400	------	1,2E0	1.1E0	1.3E0	------	1.3E1	------	7.E-1
14	1,600	------	1.1E0	1.1E0	1.1E0	------	1.5E1	------	-------
16	1,000	------	1.1E0	1.3E0	8.2E-1	------	1.1E1	------	-------
18	1,400	------	1.2E0	1.4E	1.1E0	------	1.4E1	------	4.7E-1
20	1,700	------	1.8E0	2.0E0	1.6E0	1.1E0	------	------	8.4E-1

Table 5, cont.

Borehole #9 — Radionuclide Concentrations [pCi/g]

Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
00	1,400	------	2.2E0	2.3E0	2.0E0	------	------	------	3.2E-1
02	22,000	4.6E1	5.6E1	5.6E1	5.5E1	3.5E1	1.1E1	3.1E1	-------
03	11,000	------	5.4E0	4.2E0	6.5E0	------	1.2E1	------	-------
04	2,000	------	1.3E0	1.3E0	1.4E0	------	9.3E0	------	-------
06	600	------	7.0E-1	8.4E-1	5.6E-1	------	3.8E0	------	-------
08	1,000	------	9.8E-1	7.8E-1	1.2E0	------	6.1E0	------	-------
10	900	------	8.0E-1	9.5E-1	6.5E-1	------	5.E0	1.6E0	-------
12	1,000	------	1.1E0	1.3E0	1.0E0	------	8.1E0	------	3.4E-1
14	700	2.7E0	7.7E1	8.3E-1	7.0E-1	------	4.9E0	------	5.0E-1
16	1,100	------	1.0E0	1.0E0	1.0E0	------	------	------	4.7E-1
18	1,300	------	-------	------	------	------	------	------	-------
20	1,000	7.6E-1	1.1E0	1.2E0	9.8E-1	------	8.7E0	------	-------
22	1,200	------	1.3E0	1.3E0	1.2E	------	9.5E0	------	5.3E-1

Borehole #10 — Radionuclide Concentrations [pCi/g]

Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
00	7,000	------	3.5E0	3.3E0	3.7E0	9.4E-1	3.6E0	------	-------
01	35,000	------	1.4E1	9.2E0	1.8E1	4.4E0	3.6E0	------	-------
02	>50,000	------	4.2E2	3.7E2	4.8E2	------	------	------	-------
03	>50,000	------	4.8E2	4.4E2	5.2E2	------	------	------	-------
04	35,000	------	2.5E1	1.8E1	3.E1	------	------	------	-------
05	13,000	------	9.4E0	8.3E0	1.E1	------	------	------	-------
06	4,500	------	1.2E1	1.4E1	1.0E1	3.9E0	------	5.0E0	3.1E-1
08	2,000	------	1.3E1	1.1E1	1.5E1	------	------	------	2.4E-1
10	1,800	7.3E1	1.2E2	1.3E2	1.0E2	7.0E1	------	4.5E1	-------
12	2,000	1.2E1	1.6E1	1.8E1	1.3E1	1.1E1	4.2E0	1.1E1	-------
14	500	4.9E0	5.1E0	6.1E0	4.0E0	2.7E0	3.0E0	------	-------

Borehole #11 — Radionuclide Concentrations [pCi/g]

Depth	Gross NaI	Ra-226	Pb-214	Bi-214	U-238	Ra-223	K-40	Pb-211	Pb-212
00	>50,000	8.4E1	6.6E1	1.0E2	------	2.2E1	5.6E0	------	-------
01	>50,000	3.6E3	2.9E3	4.4E3	7.7E2	------	------	------	-------
02	>50,000	1.3E4	-------	1.3E4	2.9E3	------	------	------	-------
03	>50,000	1.7E3	1.1E3	.2E3	------	------	------	------	-------
04	30,000	7.0E0	5.3E0	8.6E0	------	------	------	------	-------
05	22,000	4.9E0	4.6E0	5.2E0	------	3.6E0	1.3E1	7.1E0	7.4E0

Table 5, cont.

Borehole #11, cont. — Radionuclide Concentrations [pCi/g]

Depth	Gross NaI	Ra-226	Pb-214	Bi-214	U-238	Ra-223	K-40	Pb-211	Pb-212
06	20,000	7.1E0	7.4E0	6.7E0	------	4.6E0	1.5E1	------	
07	20,000	8.3E0	8.8E0	7.8E0	------	------	1.1E1	------	
08	20,000	1.3E1	1.5E1	1.2E1	------	2.0E1	1.0E1	5.8E0	-------
09	20,000	------	-------	------	------	------	------	------	-------

Borehole #16 — Radionuclide Concentrations [pCi/g]

Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
02	6,000	1.3E1	1.4E1	1.6E1	1.1E1	4.3E0	6.2E0	6.1E0	-------
03	9,000	------	1.8E1	2.2E1	1.5E1	6.9E0	7.9E0	8.8E0	-------
04	33,000	2.8E1	5.0E1	5.9E1	4.2E1	2.0E1	5.0E0	1.6E1	-------
05	48,000	6.5E1	1.1E2	1.3E2	9.8E1	5.6E1	1.0E1	3.7E1	-------
06	35,000	------	1.2E2	1.4E2	1.0E2	7.8E1	6.7E0	4.3E1	-------
07	9,000	------	4.8E1	5.5E1	3.1E1	3.1E1	------	2.0E1	8.2E-1
08	6,000	1.2E1	1.4E1	1.5E1	1.2E1	4.8E0	3.7E0	------	-------
09	15,000	------	1.5E1	1.7E1	1.3E1	7.0E0	4.1E0	5.5E0	-------
10	35,000	------	5.8E1	6.6E1	5.0E1	7.5E1	2.3E0	2.5E1	-------
11	>50,000	1.7E2	3.8E2	4.5E2	3.1E2	1.7E2	------	1.4E2	8.5E-1
12	>50,000	1.9E2	5.1E2	6.0E2	4.8E2	3.0E2	------	1.4E2	2.8E0
13	>50,000	1.2E2	2.4E2	2.4E2	2.4E2	7.2E1	------	2.6E1	-------
14	>50,000	3.3E2	5.4E2	4.7E2	6.0E	2.4E2	------	4.0E2	-------
15	>50,000	------	9.2E3	6.9E3	1.1E4	------	------	------	-------
16	>50,000	------	7.7E3	6.1E3	9.2E3	------	------	------	-------
17	37,000	------	8.2E1	8.1E1	8.3E1	1.6E1	5.7E0	2.6E1	-------
18	8,000	------	2.9E1	3.0E1	2.7E1	6.1E0	------	1.5E1	-------
19	6,000	1.3E1	3.4E1	4.2E1	2.6E1	1.5E2	------	1.9E1	-------

Borehole #17 — Radionuclide Concentrations [pCi/g]

Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
00	700	------	1.2E0	1.1E0	1.2E0	------	4.4E0	------	-------
02	600	------	5.4E-1	5.3E-1	5.4E-1	------	2.3E0	------	1.3E-1
04	300	------	3.3E-1	3.7E-1	2.9E-1	------	1.8E0	------	1.8E-1
06	250	------	2.6E-1	2.4E-1	2.7E-1	------	1.9E0	------	-------
08	300	------	2.4E-1	2.9E-1	1.9E-1	------	------	------	-------
10	300	------	2.9E-1	3.6E-1	2.2E-1	------	2.0E0	------	-------
12	400	------	2.7E-1	------	2.7E-1	------	3.0E0	------	2.1E-1
14	700	------	5.9E-1	5.3E-1	6.5E-1	------	4.7E0	------	6.5E-1

Table 5, cont.

Borehole #17, cont.				Radionuclide Concentrations [pCi/g]					
Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
-----	-------	------	-------	------	------	------	------	------	-------
16	1,500	------	1.2E0	------	1.2E0	------	1.E1	------	-------
18	800	------	1.5E0	1.5E0	1.4E0	------	5.3E0	------	-------
20	3,000	------	8.5E0	9.0E0	8.0E0	2.9E0	6.5E0	------	-------
22	1,000	------	1.6E0	1.7E0	1.5E0	------	4.3E0	------	-------

Borehole #18				Radionuclide Concentrations [pCi/g]					
Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
-----	-------	------	-------	------	------	------	------	------	-------
00	1,000	------	-------	------	------	------	------	------	-------
02	1,500	------	1.3E0	1.3E0	1.2E0	7.2E-1	7.8E0	------	-------
04	1,100	------	9.3E-1	1.0E0	8.3E-1	------	------	------	-------
06	1,000	------	9.9E-1	1.1E0	8.8E-1	------	6.90E	------	-------
08	600	------	4.1E-1	3.3E-1	4.8E-1	------	2.5E0	------	-------
10	600	------	5.7E-1	6.5E-1	4.9E-1	------	2.5E0	------	-------
12	1,100	------	7.7E-1	9.4E-1	6.1E-1	------	------	------	-------
14	1,000	------	6.7E-1	7.2E-1	6.1E-1	------	------	------	-------
16	1,000	------	7.6E-1	1.0E0	5.0E-1	------	------	------	4.8E-1
18	1,200	------	-------	------	------	------	------	------	-------

Borehole #19				Radionuclide Concentrations [pCi/g]					
Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
-----	-------	------	-------	------	------	------	------	------	-------
00	1,000	------	1.3E0	1.4E0	1.3E0	------	1.6E0	------	-------
02	1,700	------	3.9E0	4.3E0	3.4E0	2.1E0	4.4E0	------	4.1E-1
04	2,100	------	3.9E0	4.2E0	3.5E0	------	1.4E1	------	8.1E-1
06	4,400	------	6.0E0	6.3E0	5.8E0	2.3E0	1.0E1	------	8.6E-1
07	28,000	3.3E1	3.7E1	3.5E1	3.9E1	2.2E1	1.3E1	2.5E1	-------
08	>50,000	4.2E1	3.4E2	3.4E2	3.4E2	2.3E2	7.5E0	2.3E2	-------
09	17,000	2.7E1	1.9E1	1.7E1	2.2E1	5.3E0	------	1.3E1	-------
10	4,600	------	4.2E0	3.9E0	4.4E0	------	6.1E0	------	-------
12	1,000	------	6.5E-1	6.0E-1	7.0E-1	------	4.9E0	------	-------
14	600	------	8.6E-1	1.1E0	6.4E-1	------	------	------	2.1E-1
16	500	------	6.4E-1	7.1E-1	5.7E-1	------	2.4E0	------	-------

Table 5, cont.

Borehole #20				Radionuclide Concentrations [pCi/g]					
Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
00	10,000	------	8.9E0	3.8E0	1.4E1	6.9E0	6.8E0	------	-------
01	23,000	------	7.2E1	6.8E1	7.6E1	4.3E1	1.0E1	3.9E1	-------
02	9,000	------	1.4E1	9.9E0	1.7E1	2.9E0	8.2E0	1.7E1	-------
03	2,200	------	2.7E0	------	2.7E0	------	6.0E0	------	-------
05	900	------	1.3E0	1.4E0	1.1E0	------	------	------	-------
07	700	------	1.2E0	1.2E0	1.1E0	------	9.9E0	------	-------
09	1,000	------	1.5E0	2.0E0	1.0E0	------	1.5E1	------	-------
11	1,600	------	1.9E0	1.9E0	1.8E0	------	2.7E1	------	1.3E0
13	1,200	------	1.2E0	1.3E0	------	------	------	------	1.2E0
15	1,100	------	1.2E0	1.3E0	1.1E0	------	1.8E0	------	6.6E-1
17	500	------	7.0E-1	7.7E-1	6.4E-1	------	------	------	3.6E-1

Borehole #21				Radionuclide Concentrations [pCi/g]					
Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
00	14,000	2.1E1	3.4E1	4.2E1	2.7E1	------	------	------	-------
01	13,000	------	1.3E1	1.3E1	1.2E1	3.2E0	1.8E0	------	-------
02	1,300	------	1.2E0	9.5E-1	1.4E0	------	2.1E0	------	-------
03	1,300	------	1.3E0	1.3E0	1.3E0	------	------	------	-------
04	7,000	------	5.4E0	5.2E0	5.6E0	------	------	------	-------
05	46,000	1.8E1	6.2E1	6.0E1	6.4E1	3.2E1	9.2E0	2.1E1	-------
06	>50,000	1.7E1	6.6E2	5.4E2	7.8E2	------	------	3.3E2	-------
07	>50,000	4.5E2	3.2E3	2.8E3	3.7E3	8.3E2	------	1.5E3	-------
08	>50,000	3.2E1	7.3E1	6.7E1	7.9E1	2.9E1	------	3.2E1	-------
09	32,000	------	3.6E1	3.6E1	3.5E1	9.3E0	8.2E0	1.2E1	-------
10	9,000	------	2.2E1	2.8E1	2.0E1	1.9E0	5.6E0	------	-------
11	4,300	------	1.5E1	1.7E1	1.2E1	------	3.3E0	------	-------
12	6,000	------	5.8E0	6.2E0	5.4E0	------	5.9E0	------	-------
13	7,000	------	8.1E0	8.8E0	7.3E0	3.8E0	1.1E1	------	8.5E-1
14	7,000	------	1.3E1	1.5E1	1.1E1	6.1E0	1.1E1	------	-------
15	10,000	5.6E0	1.1E1	1.3E1	9.4E0	5.3E0	9.4E0	5.1E0	6.7E-1
16	8,000	------	6.5E0	7.2E0	5.7E0	3.2E0	4.4E0	------	-------
17	,000	------	6.1E0	7.1E0	5.2E0	3.7E0	3.1E0	------	-------
18	3,500	5.6E0	5.7E6	6.4E0	4.4E9	2.7E0	3.0E0	------	-------
20	3,000	------	6.9E0	8.3E0	5.5E0	4.4E0	------	------	-------

Table 5, cont.

Borehole #22				Radionuclide Concentrations [pCi/g]					
Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
00	10,000	------	2.4E1	2.7E1	2.1E1	1.6E1	2.7E0	------	-------
01	13,000	2.0E1	3.2E1	3.8E1	2.5E1	1.5E1	5.9E0	1.7E1	5.6E-1
02	11,000	1.9E1	2.8E1	3.2E1	2.5E1	1.6E1	4.1E0	1.5E1	-------
03	4,300	------	5.6E0	6.3E0	4.9E0	2.2E0	4.1E0	------	6.7E-1
04	5,500	------	1.1E1	1.2E1	8.8E0	5.9E0	6.5E0	------	-------
06	4,500	------	8.1E0	9.4E0	6.7E0	5.4E0	3.8E0	5.7E0	3.6E-1
07	5,000	9.4E0	8.9E0	1.0E1	7.3E0	5.4E0	6.3E0	------	7.0E-1
08	5,000	1.0E1	1.0E1	1.3E1	8.4E0	7.1E0	3.7E0	6.6E0	-------
10	4,300	------	1.5E1	1.8E1	1.2E1	7.3E0	2.8E0	5.E0	-------
12	7,000	------	1.4E1	1.7E1	1.1E1	------	4.1E0	------	-------
13	4,000	1.5E1	1.4E1	1.6E1	1.1E1	6.9E0	2.9E0	6.1E0	-------
14	7,000	9.1E0	1.3E1	1.6E1	1.1E1	4.7E0	4.8E0	------	-------
15	9,000	------	2.3E1	2.9E1	1.7E1	1.3E1	3.7E0	1.0E1	-------
16	8,000	------	2.3E1	2.8E1	1.9E1	1.6E1	2.0E0	1.1E1	-------
17	3,500	7.3E0	7.4E0	8.3E0	6.4E0	5.0E0	2.3E0	------	-------
18	7,000	1.8E1	1.8E1	2.0E1	1.5E1	6.1E0	------	------	-------
19	9,000	------	1.7E1	2.0E1	1.4E1	1.2E1	3.8E0	------	-------
20	13,000	------	3.5E1	4.0E1	3.0E1	2.5E1	3.7E0	1.5E1	-------
21	10,000	------	1.1E1	1.1E1	1.1E1	3.5E0	3.6E0	------	-------
22	24,000	------	1.9E1	1.6E1	2.1E1	4.1E0	4.3E0	6.3E0	-------
23	>50,000	------	5.8E3	5.8E3	5.8E3	3.0E2	------	2.6E2	-------
24	>50,000	------	7.0E2	6.4E2	7.5E2	2.9E2	------	3.3E2	-------
25	>50,000	------	6.4E2	6.4E2	6.4E2	3.6E2	------	3.4E2	-------

Borehole #31				Radionuclide Concentrations [pCi/g]					
Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
00	1,200	------	6.5E-1	5.6E-1	7.4E-1	------	7.8E0	------	5.6E-1
02	900	------	5.6E-1	5.9E-1	5.3E-1	------	------	------	4.5E-1
04	1,500	------	9.1E-1	9.3E-1	8.9E-1	------	6.5E0	1.7E0	-------
06	1,000	------	6.3E-1	6.4E-1	6.3E-1	------	6.1E0	------	-------
08	800	------	5.1E-1	4.5E-1	5.7E-1	------	------	------	-------
10	800	------	4.9E-1	5.2E-1	4.5E-1	------	------	------	3.8E-1
12	1,500	------	3.7E-1	3.7E-1	------	------	3.7E0	------	-------
14	1,100	------	7.1E-1	------	7.1E-1	------	1.3E1	------	-------
16	1,000	------	5.1E-1	------	5.1E-1	------	4.0E0	------	3.1E-1
18	1,500	8.5E-1	8.1E-1	8.6E-1	7.7E-1	------	8.1E0	------	8.0E-1

Table 5, cont.

Borehole #31, cont. — Radionuclide Concentrations [pCi/g]

Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
20	600	------	4.9E-1	4.8E-1	5.0E-1	------	------	------	6.2E-1
22	1,300	------	7.1E-1	8.4E-1	5.9E-1	------	------	------	-------
24	1,300	------	1.1E0	1.1E-1	1.0E0	------	6.2E0	------	-------

Borehole #32 — Radionuclide Concentrations [pCi/g]

Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
00	16,000	------	8.3E0	6.5E0	1.0E1	2.0E0	2.2E0	------	-------
01	>50,000	------	1.5E2	1.4E2	1.6E2	1.1E2	------	6.9E1	-------
02	17,000	------	4.9E1	4.1E1	5.7E1	2.0E1	3.9E0	1.9E1	-------
03	5,000	------	3.1E0	2.1E0	4.2E0	------	------	------	-------
04	1,300	------	3.1E0	2.1E0	4.2E0	------	------	------	-------
06	1,700	------	1.7E0	1.9E0	1.4E0	------	------	------	3.1E-1
08	1,700	------	1.9E0	2.2E0	1.6E0	------	8.2E0	------	3.8E-1
10	1,700	------	1.8E0	2.0E0	1.5E0	------	1.2E1	------	-------
12	1,600	------	1.6E0	1.7E0	1.5E0	------	1.2E1	------	6.0E-1
14	1,600	------	2.6E0	2.7E0	2.4E0	------	------	------	-------
16	1,800	------	1.7E0	1.5E0	1.9E0	------	------	------	7.1E-1
18	1,900	------	9.3E-1	8.7E-1	9.9E-1	------	1.4E1	------	8.5E-1

Auger Hole NaI (Tl) Counts

Table 5, cont.

Borehole #2		Borehole #7		Borehole #12	
Depth	NaI CPM	Depth	NaI CPM	Depth	NaI CPM
ft		ft		ft	
00	700	00	>50,000	00	1,000
01	1,300	01	>50,000	01	1,500
02	1,000	02	>50,000	02	1,300
03	1,000	03	23,000	03	2,000
04	1,400	04	7,000	04	3,000
05	1,000	05	3,600	05	3,500
06	1,400	06	1,300	06	1,500
07	1,400	07	1,000	07	1,000
08	1,300	08	1,000	08	800
09	1,200	09	1,100	09	700
10	1,000	10	1,000	10	700
11	700	11	1,100	11	500
12	800	12	1,200	12	500
13	800	13	1,400	13	350
14	1,200	14	1,200	14	350
15	3,500	15	1,200	15	500
16	11,000	16	1,400	16	350
17	2,500	17	1,500	17	900
18	1,400	18	1,700	18	900
19	1,000	19	1,700	19	1,000
20	1,000	20	4,000	20	1,500
21	800	21	2,200	21	1,500
22	1,000	22	2,000	22	1,300
23	800	--	-----	23	500
24	800	--	-----	24	600
25	800	--	-----	--	-----
26	1,500	--	-----	--	-----
26	1,500	--	-----	--	-----
27	1,000	--	-----	--	-----
28	800	--	-----	--	-----
29	600	--	-----	--	-----
30	600	--	-----	--	-----
31	500	--	-----	--	-----
32	700	--	-----	--	-----
33	1,000	--	-----	--	-----
34	1,000	--	-----	--	-----
35	1,000	--	-----	--	-----

Borehole #13		Borehole #23		Borehole #24	
00	900	00	1,100	--	-----
01	1,300	01	1,100	01	1,200
02	800	02	700	02	2,000
03	600	03	1,200	03	1,600
04	700	04	1,300	04	1,800
05	400	05	900	05	1,600
06	500	06	600	06	1,500

Table 5, cont.

Borehole #13		Borehole #23		Borehole #24	
Depth	NaI CPM	Depth	NaI CPM	Depth	NaI CPM
ft		ft		ft	
07	400	07	400	07	1,000
08	700	08	300	08	1,000
09	1,000	09	300	09	300
10	900	10	300	10	700
11	600	11	400	11	1,000
12	600	12	400	12	1,800
13	900	13	500	13	1,200
14	600	14	600	14	1,500
15	500	15	600	15	700
16	600	16	400	16	600
17	700	17	500	17	500
18	1,000	18	700	18	1,000
19	800	19	600	19	900
20	900	20	600	20	1,200
21	800	21	500	21	1,500
22	800	22	400	22	800
23	700	--	-----	23	500
24	900	--	-----	24	500

Borehole #25		Borehole #26		Borehole #27	
00	1,200	--	-----	--	-----
01	1,900	01	1,600	01	1,300
02	1,800	02	2,500	02	1,800
03	2,600	03	2,600	03	1,200
04	2,400	04	3,500	04	1,200
05	2,200	05	19,000	05	1,300
06	12,000	06	10,000	06	600
07	19,000	07	2,100	07	700
08	5,000	08	1,300	08	300
09	1,900	09	800	09	300
10	1,700	10	500	10	600
11	800	11	500	11	700
12	1,100	12	500	12	700
13	800	13	600	13	600
14	500	14	500	14	1,000
15	700	15	600	15	1,300
16	800	16	1,100	16	800
17	500	17	800	17	900
18	500	18	600	18	500
19	700	19	900	19	400
20	400	20	1,200	20	500
21	400	21	1,000	21	500
22	400	22	1,200	22	700
23	400	23	900	23	1,000
24	900	24	600	24	1,000
25	1,000	25	500	--	-----
26	600	26	800	--	-----

Table 5, cont.

Borehole #25		Borehole #26		Borehole #27	
Depth	NaI CPM	Depth	NaI CPM	Depth	NaI CPM
ft		ft			
27	400	27	500	--	-----
28	500	28	500	--	-----
29	600	29	600	--	-----
30	700	30	500	--	-----
31	700	31	600	--	-----
32	1,000	32	700	--	-----
33	1,700	33	900	--	-----
34	1,100	34	600	--	-----
35	1,000	35	800	--	-----
36	1,600	36	1,500	--	-----
37	1,700	37	1,500	--	-----
38	1,100	38	1,000	--	-----
--	-----	39	1,000	--	-----

Borehole #28		Borehole #29		Borehole #30	
01	1,600	01	1,300	01	600
02	1,200	02	1,300	02	600
03	600	03	1,300	03	800
04	700	04	1,000	04	300
05	1,000	05	800	05	500
06	1,500	06	1,200	06	400
07	1,400	07	1,800	07	500
08	1,100	08	1,400	08	300
09	1,400	09	2,000	09	600
10	1,800	10	2,000	10	1,100
11	1,900	11	1,200	11	600
12	2,800	12	1,200	12	800
13	2,900	13	1,500	13	700
14	9,000	14	1,700	14	1,000
15	32,000	15	1,300	15	1,200
16	4,200	16	600	16	800
17	2,000	17	500	17	300
18	1,600	18	500	18	250
19	1,200	19	600	19	400
20	1,300	20	700	20	500
21	1,100	21	600	21	700
22	500	22	600	22	600
23	500	23	500	23	500
--	-----	--	-----	24	400
--	-----	--	-----	25	600
--	-----	--	-----	26	1,200
--	-----	--	-----	27	500
--	-----	--	-----	28	300
--	-----	--	-----	29	300
--	-----	--	-----	30	600
--	-----	--	-----	31	500
--	-----	--	-----	32	400
--	-----	--	-----	33	400

Table 5, cont.

Borehole #33		Borehole #34		Borehole #35	
Depth	NaI CPM	Depth	NaI CPM	Depth	NaI CPM
ft		ft		ft	
01	1,900	01	2,600	01	10,000
02	1,200	02	1,300	02	38,000
03	800	03	1,400	03	>50,000
04	700	04	1,000	04	>50,000
05	600	05	1,500	05	22,000
06	1,000	06	1,500	06	22,000
07	1,000	07	1,000	07	1,500
08	800	08	400	08	1,500
09	800	09	300	09	800
10	500	10	400	10	700
11	500	11	500	11	700
12	400	12	800	12	600
13	300	13	700	13	00
14	00	14	500	14	1,100
15	400	15	600	15	1,400
16	500	16	900	16	1,400
17	900	17	600	17	800
18	900	18	700	18	700
19	1,000	19	1,300	19	600
20	1,100	20	800	20	600
21	800	21	400	21	600
22	800	22	300	22	700
--	-----	23	300	--	-----

Borehole #36		Borehole #37		Borehole #38	
01	1,200	01	1,500	01	7.000
02	700	02	1,400	02	7,000
03	900	03	1,100	03	8,000
04	1,600	04	1,100	04	12,000
05	1,800	05	1,200	05	22,000
06	2,500	06	1,500	06	>50,000
07	5,000	07	1,700	07	>50,000
08	1,700	08	800	08	>50,000
09	1,000	09	800	09	>50,000
10	800	10	800	10	>50,000
11	900	11	1,000	11	>50,000
12	700	12	1,600	12	21,000
13	700	13	1,400	13	7,000
14	800	14	1,500	14	5,000
15	500	15	1,700	15	1,600
16	500	16	1,900	16	1,000
17	600	17	1,800	17	1,000
18	900	18	1,400	18	600
19	800	19	900	19	800
20	700	20	1,000	20	600
21	600	21	1,500	21	400
--	-----	22	600	22	700
--	-----	23	600	23	1,000
--	-----	24	500	--	-----

Table 5, cont.

Borehole #39		Borehole #40		Borehole #41	
Depth	NaI CPM	Depth	NaI CPM	Depth	NaI CPM
ft		ft		ft	
01	3,000	01	7,000	01	1,400
02	11,000	02	26,000	02	1,400
03	4,000	03	6,000	03	1,200
04	1,900	04	2,100	04	1,500
05	1,000	05	1,600	05	1,900
06	1,500	06	1,900	06	1,200
07	1,000	07	3,500	07	700
08	700	08	5,000	08	600
09	500	09	3,200	09	700
10	500	10	1,500	10	1,000
11	400	11	800	11	1,000
12	500	12	1,200	12	1,300
13	400	13	1,500	13	1,000
14	800	14	1,500	14	600
15	1,200	15	1,300	15	600
16	1,300	16	1,000	16	600
17	900	17	800	17	500
18	600	18	600	18	500
19	700	19	1,200	19	200
20	1,000	20	1,200	20	200
--	-----	21	1,300	21	300
--	-----	22	1,300	22	300
--	-----	--	-----	23	300
--	-----	--	-----	24	500

Water Sample Analysis Results

Table 6

Sample No.	Date	Location	Gross Alpha pCi/l		Gross Beta pCi/l	
7001	6/8/81	Surface Water North of Shuman Building	3.11E0	+/-8.8%	2.25E1	+/-3.0%
7002	6/9/81	Surface Water West of Shuman Building	8.00E0	+/-9.9%	2.34E1	+/-4.4%
7003	6/10/81	Drainage Pipe at NE Boundary	1.56E0	+/-22%	9.88E0	+/-6.8%
7004	6/11/81	Stream Beneath Earth City Expressway (offsite)	1.04E0	+/-14%	1.97E1	+/-4.8%
7009	6/29/81	Borehole #14	4.50E0	+/-39%	2.23E1	+/-14%
7010	6/29/81	Borehole #15	2.60E0	+/-52%	1.52E1	+/-17%
7011	6/18/81	Borehole #14	3.12E0	+/-47%	1.06E1	+/-20%
7012	6/18/81	Borehole #15	7.10E0	+/-31%	1.66E1	+/-16%
7013	6/3/81	Middle Leachate Treatment Lagoon	-1.04E0	+/-275%	1.30E2	+/-5.7%
7014	6/3/81	North Leachate Treatment Lagoon	1.35E0	+/-55%	1.36E2	+/-5.5%
7015	6/3/81	South Leachment Treatment Lagoon	2.43E0	+/-55%	1.03E2	+/-6.4%
7016	6/3/81	Sludge Drainage Pipe	-1.21E0	+/-234%	9.89E1	+/-6.5%
7017	7/10/81	Borehole #14	5.20E-1	+/-115%	3.36E1	+/-11%
7018	7/10/81	Borehole #15	6.76E0	+/-32%	3.61E1	+/-11%
7019	6/29/81	Surface Pond North of Entrance on St. Charles Rock Road	1.91E0	+/-60%	3.00E1	+/-12%
7020	6/17/81	Borehole #15	8.84E0	+/-28%	3.01E1	+/-12%
7021	7/20/81	Tap Water	1.56E0	+/-67%	2.91E1	+/-12%
7022	7/10/81	Middle Leachate Treatment Lagoon	3.45E0	+/-141%	1.07E2	+/----%
7023	7/10/81	North Leachate Treatment Lagoon	-2.95E0	+/-189%	1.22E2	+/-5.8%
7024	7/10/81	South Leachment Treatment Lagoon	-1.56E0	+/-179%	8.67E1	+/-6.9%
7025	7/21/81	Settling Pond at North Boundary of Site	1.56E0	+/-67%	3.65E1	+/-11%
7026	6/17/81	Borehole #14	-8.66E-1	+/-332%	3.89E1	+/-10%
7027	5/11/81	Standing Water at Earth City Background Site	1.04E0	+/-82%	3.25E1	+/-11%
7028	4/29/81	Standing Water at NW Corner of Shuman Building	4.52E1	+/-6.2%	8.78E1	+/-6.9%
7029	4/29/81	West Ditch Runoff	-2.08E0	+/-131%	-3.62E0	+/-137%
7030	7/28/81	Pond at North Boundary of Site	5.20E-1	+/-115%	3.51E1	+/-11%
7031	7/28/81	Surface Pond North of Entrance on St. Charles Rock Road	-1.39E0	+/-203%	2.63E1	+/-13%
7032	7/30/81	Missouri River Water	-2.6E0	+/-102%	2.63E1	+/-13%
7033	7/30/81	Missouri River Water	1.04E0	+/-82%	2.90E1	+/-12%
7034	7/28/81	North Leachate Treatment Lagoon	-1.39E0	+/-203%	1.03E2	+/-6.3%
7035	7/28/81	Middle Leachate Treatment Lagoon	1.04E0	+/-82%	8.45E1	+/-7.0%

Table 6, cont.

Sample No.	Date	Location	Gross Alpha pCi/l		Gross Beta pCi/l	
7036	7/28/81	South Leachate Treatment Lagoon	-2.95E0	+/-189%	6.96E1	+/-7.7%
1	11/80	Leachate Observation Well	7.3E0	+/-120%	8.0E1	+/-25%
2	10/80	Off-site Sample Well 3, West Boundary of Landfill	1.5E1	+/-17%	4.1E1	+/-10%
3	10/80	Off-site Sample Well 4, North Boundary of Landfill	2.9E0	+/-29%	7.6E0	+/-26%
4	11/80	Settling Pond North of Landfill	2.9E0	+/-150%	2.6E1	+/-110%

Sample No.	Date	Location	Isotopic Analysis K-40 pCi/l		Ra-226 pCi/l	
7014	6/3/81	North Leachate Treatment Lagoon	1.38E2	+/-15%	1.20E0	+/-21%
7015	6/3/81	South Leachate Treatment Lagoon	1.36E2	+/-16%	3.92E0	+/-233%
7016	6/3/81	Sludge Drainage Pipe	1.02E2	+/-15%	2.40E0	+/-290%
7022	7/10/81	Middle Leachate Treatment Lagoon	1.04E2	+/-18%	2.40E0	+/-290%
7028	4/29/81	Standing Water at NE Corner Shuman Bldg.	1.24E2	+/-28%	1.15E0	+/-195%

Radon Flux Measurements Using Accumulator Method

Table 7

Date	Time	Location	Environmental Conditions	Flux pCi/sq.m-s
04/21	09:33	Base 1 (Area 2, O11J)	10 degrees C, damp ground, moderate wind	28
04/21	10:21	Base 2 (Area 2, L38K)	10 degrees C, damp ground, moderate wind	6.7
04/22	11:48	Base 1 (Area 2, O11J)	15 degrees C, soaked ground, 1 hour after rain	332
04/22	12:38	Base 3 (Area 2, M99H)	15 degrees C, soaked ground, 1 hour after rain	1.7
04/23	08:24	Base 1 (Area 2, O11J)	15 degrees C, damp ground, sunny, last rain approx. 12 hours	293
04/23	09:12	Base 3 (Area 2, M99H)	15 degrees C, damp ground, sunny, last rain approx. 12 hours	7.9
04/23	10:00	Base 2 (Area 2, L38K)	15 degrees C, damp ground, sunny, last rain approx. 12 hours	5.9
04/24	08:38	Base 3 (Area 2, M99H)	7 degrees C, damp ground, cloudy, last rain approx. 2 days	2.7
04/24	08:40	Base 1 (Area 2, O11J)	7 degrees C, damp ground, cloudy, last rain approx. 2 days	9.8
04/24	09:29	Base 2 (Area 2, L38K)	7 degrees C, damp ground, cloudy, last rain approx. 2 days	1.5
04/27	09:05	Base 3 (Area 2, M99H)	21 degrees C, hot, ground dry, sunny	2.2
04/29	08:52	Base 3 (Area 2, M99H)	18 degrees C, sunny, last rain approx. 12 hours, light breeze	14
04/29	09:36	Base 1 (Area 2, O11J)	18 degrees C, sunny, last rain approx. 12 hours, light breeze	540
04/29	11:10	Base 4 (Area 2, i00P)	18 degrees C, sunny, last rain approx. 12 hours, light breeze	63
05/04	10:05	Base 1 (Area 2, O11J)	Cloudy, drizzle, last heavy rain approx. 1 day	43
05/04	15:34	Base 1 (Area 2, O11J)	Cloudy, drizzle, last heavy rain approx. 1 day	33
05/05	09:44	Base 1 (Area 2, O11J)	Cloudy, drizzle, soaked ground, no wind	177
05/06	09:49	Base 1 (Area 2, O11J)	7 degrees C, windy, wet ground, last rain approx. 12 hours	269
05/07	09:32	Base 1 (Area 2, O11J)	10 degrees C, windy, ground dry at surface, sunny	34
05/07	10:48	Base 3 (Area 2, M99H)	10 degrees C, windy, ground dry at surface, sunny	1.5
05/08	09:45	Base 3 (Area 2, M99H)	15 degrees C, cloudy, moderate wind, ground moist	8.5
05/08	10:28	Base 4, (Area 2, i00P)	15 degrees C, cloudy, moderate wind, ground moist	243
05/11	11:43	Base 4 (Area 2, i00P)	13 degrees C, light wind, soaked ground, rain approx. 12 hours ago	28

Table 7, cont.

Date	Time	Location	Environmental Conditions	Flux pCi/sq.m-s
05/12	11:15	Base 4 (Area 2, i00P)	15 degrees C, windy, cloudy, last rain approx. 1 day	310
05/12	12:08	Base 1 (Area 2, O11J)	15 degrees C, windy, cloudy, last rain approx. 1 day	18
05/13	10:10	Base 4 (Area 2, i00P)	13 degrees C, cloudy, ground moist, last rain approx. 8 hours	206
05/13	10:50	Base 1 (Area 2, O11J)	13 degrees C, cloudy, ground moist, last rain approx. 8 hours	30
05/14	10:30	Base 5 (Area 2,)	13 degrees C, cloudy, light wind, drizzle	43
05/14	11:04	Base 6 (Area 1, I00A)	13 degrees C, cloudy, light wind, drizzle	376
05/15	09:51	Base 6 (Area 1, I00A)	15 degrees C, sunny, light wind	380
05/18	10:13	Base 6 (Area 1, I00A)	10 degrees C, cloudy, heavy rain last 2 days, strong wind	188
05/19	09:44	Base 1 (Area 2, O11J)	10 degrees C, drizzle, ground soaked	8.0
05/19	10:24	Base 4 (Area 2, i00P)	10 degrees C, drizzle, ground soaked	17
05/19	10:24	Base 6 (Area 1, I00A)	10 degrees C, drizzle, ground soaked	538
05/20	10:01	Base 1 (Area 2, O11J)	18 degrees C, no wind, sunny, ground damp	276
05/20	10:41	Base 4 (Area 2, i00P)	18 degrees C, no wind, sunny ground damp	119
05/20	11:23	Base 6 (Area 1, I00A)	18 degrees C, no wind, sunny ground damp	353
05/21	09:53	Base 1 (Area 2, O11J)	21 degrees C, sunny, no wind, dry soil	212
05/21	10:27	Base 4 (Area 2, i00P)	21 degrees C, suny, no wind, dry soil	406
05/27	08:51	Base 6 (Area 1, I00A)	21 degrees C, sunny, light breeze, dry soil	350
05/27	09:33	Base 1 (Area 2, O11J)	21 degrees C, sunny, light breeze, dry soil	596
05/27	10:12	Base 4 (Area 2, i00P)	21 degrees C, sunnny, light breze, dry soil	865
05/28	08:43	Base 4 (Area 2, i00P)	28 degrees C, dry soil, last rain 2 days 29.90" hg	400
05/28	11:44	Base 4 (Area 2, i00P)	28 degrees C, dry soil, last rain 2 days 29,90" hg	397
05/29	09:14	Area 2, k00R	29 degrees C, damp soil, light wind	1.8
06/02	08:45	Base 6 (Area 1, I00A)	30 degrees C, dry soil, 29.90" hg	620
06/03	14:54	Base 4 (Area 2, i00P)	32 degrees C, slight wind, dry soil 29.85 hg	580
06/04	09:03	Base 1 (Area 2, O11J)	34 degrees C, light wind, dry soil	388
06/04	10:10	Area 2, I00F	39 degrees C, no wind, damp soil	0.6
06/08	11:37	Base 4 (Area 2, i00P)	33 degrees C, dry soil, moderate breeze	245
06/09	09:21	Base 4 (Area 2, i00P)	33 degrees C, dry soil, slight breeze	579
06/09	10:39	Base 8 (Area 1, I00I)	33 degrees C, dry soil, strong wind	3.0
06/10	11:17	Area 2, M62J	21 degrees C, dry soil, no wind 29.92"	1.3
06/11	10:16	Area 2, U00P	18 degrees C, dry soil, light breeze	38

Table 7, cont.

Date	Time	Location	Environmental Conditions	Flux
				pCi/sq.m-2
06/11	10:39	Area 2, T00P	18 degrees C, dry soil, light breeze	85
06/11	12:07	Area 2, h00X	18 degrees C, dry soil, light breeze	1.8
06/11	12:20	Area 2, j00W	18 degrees C, dry soil, light breeze	1.9
06/12	09:56	Area 2, U00P	26 degrees C, damp soil, light breeze 29.98" hg	14
06/12	10:08	Area 2, T00P	26 degrees C, damp soil, light breeze 29.98" hg	35
06/12	11:20	Area 2, h00X	26 degrees C, damp soil, light breeze 29,98" hg	0.6
06/12	11:30	Area 2, j00W	26 degrees C, damp soil, light breeze 29.98" hg	1.0
06/15	10:03	Area 2, I00L	29 degrees C, dry soil, gusty, 760.5mm hg	0.8
06/15	10:15	Area 2, J00L	29 degrees C, dry soil, gusty, 760.5mm hg	0.7
06/23	10:17	Earth City, offsite bkg	27 degrees C, damp soil, no wind 30.14 hg	0.5
06/23	13:50	Taussig Rd, offsite bkg	27 degrees C, damp soil, no wind 30.14 hg	1.5
06/29	10:03	Area 2m U00P	n/a	16
07/06	10:20	Base 4 (Area 2, i00P)	Damp soil, slight breeze	138
07/06	11:24	Taussig Rd, offsite bkg	Damp soil, slight breeze	0.3
07/08	14:00	Area 2, J30L	31 degrees C, dry soil, slight breeze, 30.20" hg	0.4
07/08	14:30	Area 2, H04O	31 degrees C, dry soil, slight brze, 30.20" hg	0.4
07/10	10:19	Taussig Rd, offsite bkg	Damp soil, started to rain during accumulation	0.3
07/10	10:09	Old St. Charles Rock Rd Bkg	Damp soil, started to rain during accumulation	1.0
07/16	10:49	Area 1, M10G	26 degrees C, damp soil, 29.96" hg	22
07/17	10:10	Area 1, M10G	25 degrees C, dry soil, no wind, 30.02" hg	14
07/20	10:25	Base 6 (Area 1, I00A)	30 degrees C, damp soil, mild wind, 29.86" hg	59
07/22	11:25	Old St. Charles Rock Rd Bkg	26 degrees C, damp soil, no wind 30.10" hg	<0.1
07/24	08:14	Area 1, M10G	24 degrees C, damp soil, light wind, 30.06" hg	15
07/24	08:31	Area 2, p07S	24 degrees C, damp soil, light wind, 30.05" hg	168
07/28	09:05	Area 2, p07S	23 degrees C, damp soil, mild wind, 30.06" hg	34
07/28	09:23	Area 1, M10G	23 degrees C, damp soil, mild wind, 30.06" hg	61
07/29	08:09	Base 8 (Area 1, I00I)	18 degrees C, damp soil, light wind, 30.21" hg	0.5
07/29	08:26	Area 2, p07S	18 degrees C, damp soil, light wind, 30.21" hg	173
07/29	10:04	Old St. Charles Rock Rd Bkg	21 degrees C, damp soil, light wind, 30.21" hg	0.3
07/29	10:50	Taussig Road offsite bkg	21 degrees C, damp soil, light wind, 30.21" hg	0.2
07/30	08:09	Area 2, p07S	23 degrees C, dry soil, sunny, light wind, 30.21" hg	38
07/30	08:16	Area 1, O00M	23 degrees C, dry soil, sunny, light wind, 30.21" hg	3.2
07/30	09:20	Old St. Charles Rock Rd Bkg	23 degrees C, dry soil, sunny, light wind, 30.21'hg	0.2
07/31	10:08	Area 1, O00M	24 degrees C, very dry soil, sunny, light wind, 30.25" hg	2.0

Table 7, cont.

Date	Time	Location	Environmental Conditions	Flux
				pCi/sq.m-2
07/31	10:13	Area 1, E00F	24 degrees C, very dry soil, sunny, light wind, 30.25" hg	0.5
08/03	10:11	Area 1, E00F	25 degrees C, dry soil, light wind, 29.94" hg	3.4
08/03	10:14	Area 1, O00M	25 degrees C, dry soil, light wind, 29.94" hg	0.4
08/04	09:05	Area 1, E00F	29 degrees C, dry soil, light wind, 30.04" hg	6.4
08/04	09:11	Area 1, O00M	29 degrees C, dry soil, light wind, 30.04" hg	0.5
08/05	09:21	Area 1, E00F	28 degrees C, dry soil, light wind, 30.07" hg	9.6
08/05	09:25	Area 1, O00M	28 degrees C, dry soil, light wind, 30.07" hg	9.6
08/06	08:35	Area 1, E00F	27 degrees C, dry soil, light wind, 30.01" hg	0.4
08/06	08:40	Area 1, M10G	27 degrees C, dry soil, light wind, 30.01" hg	5.1
08/07	09:08	Area 2, p07S	27 degrees C, dry soil, light wind, 30.01" hg	122
08/07	09:15	Base 8 (Area 1, I00I)	27 degrees C, dry soil, light wind, 30.01" hg	0.4
08/17	10:05	Area 2, I00F	20 degrees C, dry soil, light wind, 30.08" hg	0.6
08/17	10:10	Area 2, I00L	20 degrees C, dry soil, light wind, 30.08" hg	0.3
08/18	09:14	Area 2, I00L	18 degrees C, dry soil, no wind, 30.11" hg	<0.1
08/18	09:17	Area 2, I00F	18 degrees C, dry soil, no wind, 30.11" hg	0.5
08/19	09:34	Area 2, I00L	18 degrees C, dry soil, no wind, 30.11" hg	0.3
08/19	09:40	Area 2, I00F	18 degrees C, dry soil, no wind, 30.11" hg	0.4

Radon Flux Measurements Using the Charcoal Canister Method

Table 8

Date	Location	Sampling Time(sec)	Enviromental Conditions	Flux pCi/sq.m-s
06/02	Base 6 (Area 1, I00a)	6,000	30 degrees C, dry soil, 29.90" hg	362
06/03	Base 4 (Area 2, i00P)	4,980	32 degrees C, dry soil, light wind, 29.85" hg	29
06/03	Base 4 (Area 2, i00P)	1,200	32 degrees C, dry soil, light wind, 29.85" hg	613
06/04	Base 1 (Area 1, O11J)	7,200	34 degrees C, dry soil light wind	147
06/10	Base 8 (Area 2, I00I)	55,320	21 degrees C, dry soil, no wind, 29.92" hg	2.0
06/10	Area 2, M00I	18,000	21 degrees C, dry soil, no wind, 29.92" hg	2.3
06/11	Area 2, L00G	60,300	18 degrees C, dry soil, light breeze	163
06/11	Area 2, U00P	22,500	18 degrees C, dry soil, light breeze	44
06/18	Area 2, 100S	54,900	n/a	2.2
06/12	Area 2, T00P	17,640	26 degrees C, damp soil, light breeze, 29.98" hg	30
06/23	Earth City, offsite bkg	21,600	27 degrees C, damp soil, no wind, 30.14" hg	0.9
06/24	Taussig Road, offsite bkg	61,200	n/a	0.8
06/30	Area 2, p00J	55,320	n/a	8.7
06/30	Area 2, U00P	20,940	n/a	74
07/01	Old St. Charles Rd, bkg	20,040	n/a	0.8
07/06	Area 2, i00P	50,400	Damp soil, light breeze	178
07/08	Area 1, H25N	14,100	31 degrees C, dry soil, slight breeze, 30.20" hg	0.9
07/08	Area 2, J30L	50,140	31 degrees C, dry soil, slight breeze, 30.20" hg	0.3
07/10	Area 1, I00L	22,540	Damp soil, during rain	0.6
07/15	Old St. Charles Rock Rd, bkg	54,540	n/a	1.6
07/16	Area 1, M10G	22,380	26 degrees C, damp soil, 29.96" hg	24
07/17	Area 1, M10G	57,240	25 degrees C, dry soil, no wind, 30.20" hg	14
07/20	Base 6 (Area 1, I00A)	5,880	30 degrees C, damp soil, mild wind, 29.86" hg	13
07/22	Old St. Charles Rock Rd, bkg	68,640	26 degrees C, damp soil, no wind, 30.10" hg	0.3
07/23	Area 1, M10G	60,960	n/a	4.5
07/28	Area 1, M10G	61,560	23 degrees C, damp soil, 30.06" hg	9.1
07/28	Area 2, p04S	63,240	23 degrees C, damp soil, 30.06" hg	32
07/29	Area 1, I00I, Base 6	57,540	18 degrees C, damp soil, light wind, 30.21"hg	0.4
07/29	Area 1, O00I	57,960	18 degrees C, damp soil, light wind, 30.21" hg	1.3
07/30	Area 2, p04S	55,080	23 degrees C, dry soil, light wind, 30.21" hg	212
07/30	Area 1, O00M	56,820	23 degrees C, dry soil, light wind, 30.21" hg	7.6
07/31	Area 1, E00F	56,340	24 degrees C, very dry soil, light wind, 30.25" hg	0.4
07/31	Area 1, O00M	56,220	24 degrees C, very dry soil, light wind, 30.25" hg	5.2
08/05	Area 1, E00F	52,800	28 degrees C, dry soil, light wind, 30.07" hg	0.6

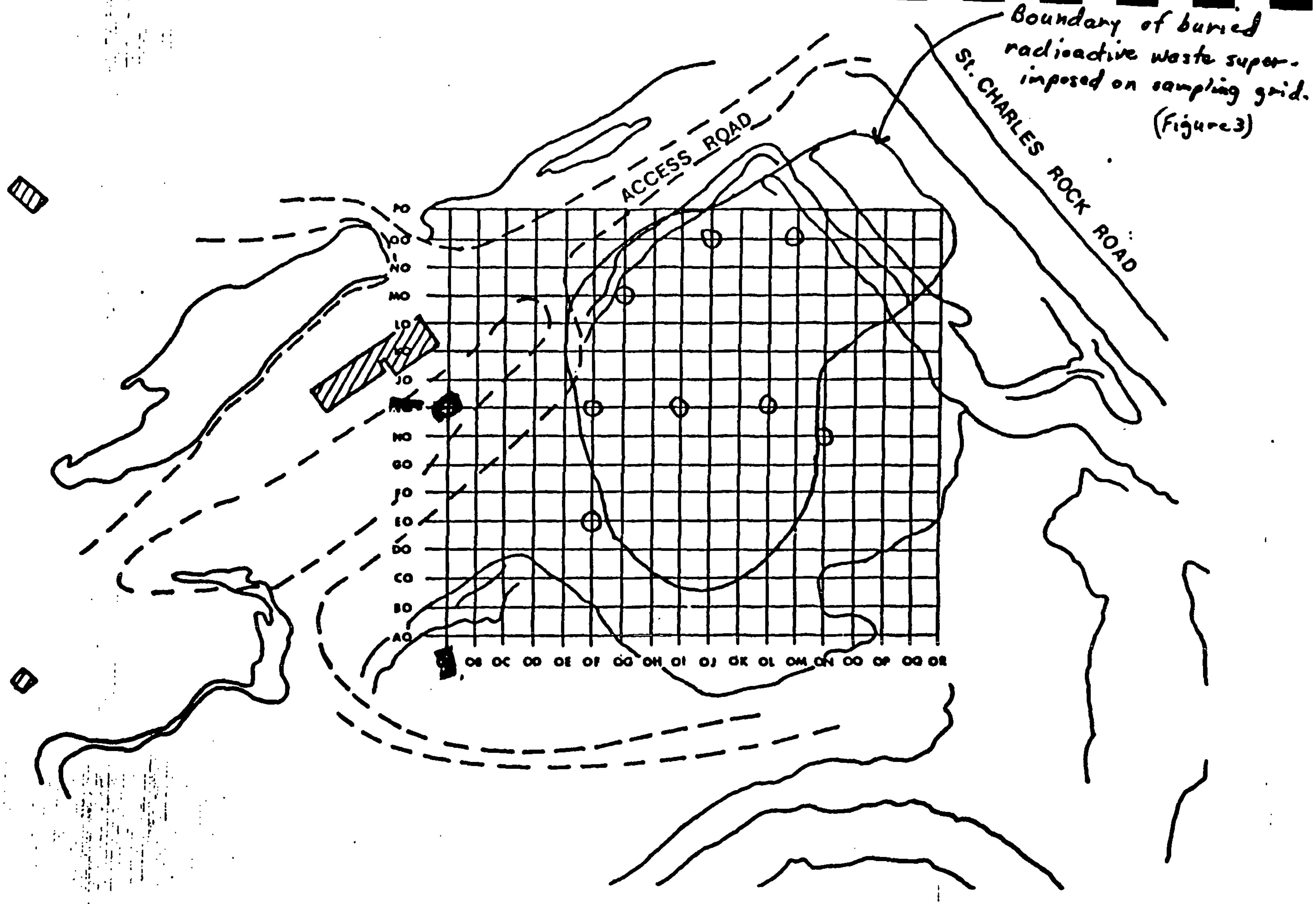


Figure 5. Grid locations for radiological survey, Area 1.

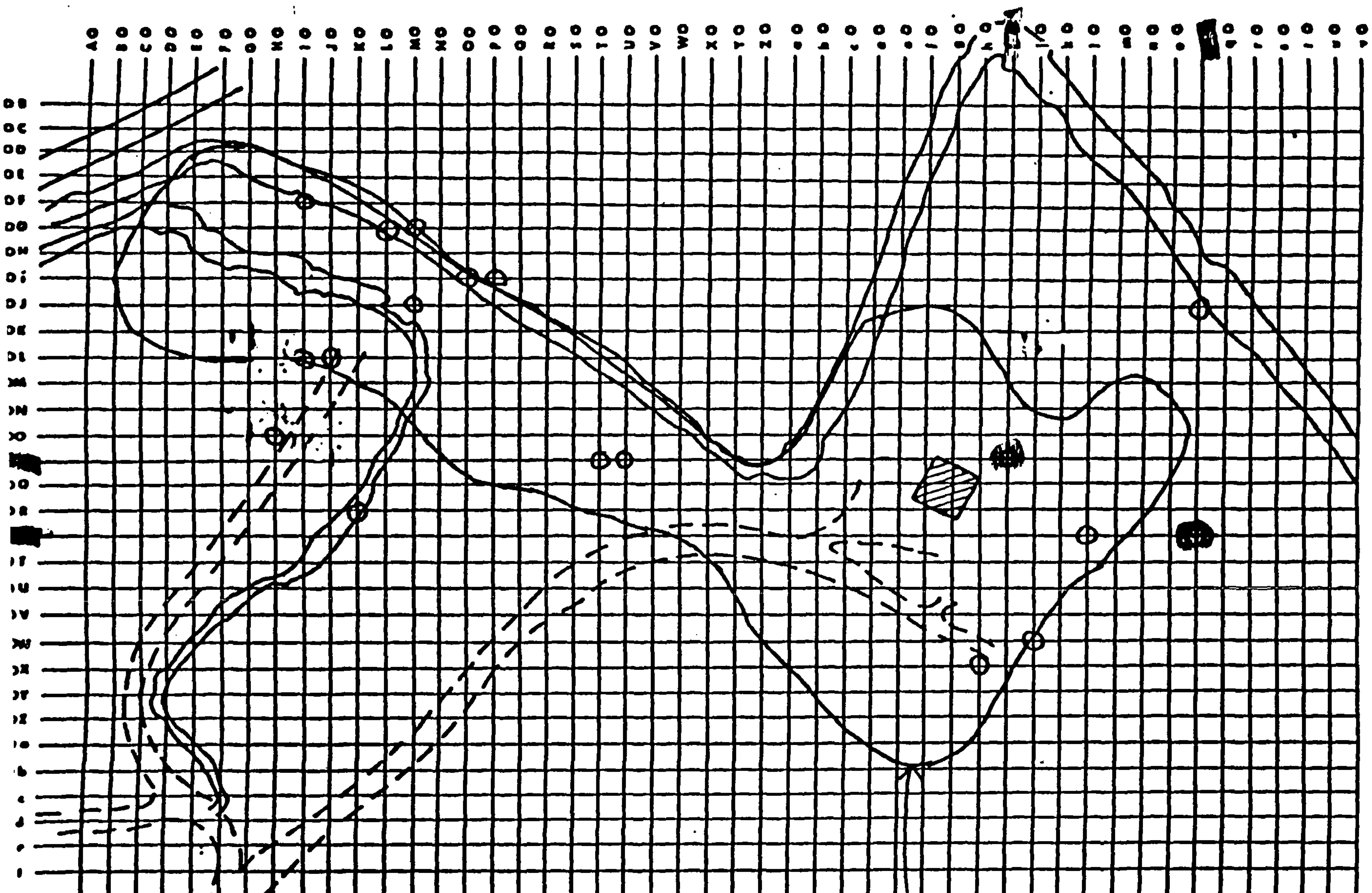


Figure 6. Grid locations for radiological survey, Area 2.

Boundary of buried radioactive waste superimposed on sampling grid. (Figure 3)

Side-By-Side Radon Flux Measurements,
Accumulator versus Charcoal Canister Methods

Table 9

Location	Date	Charcoal Canister	Accumulator
		pCi/sq.m-2	pCi/sq.m-2
Base 6	6-2	400	740
Base 4	6-3	680	790
Base 1	6-4	170	370
Base 8	6-9	2.1	3.0
Base 3	6-10	2.4	1.3
Borehole 3	6-11	50	38
T00P(Area 2)	6-12	30	35
Earth City	6-23	0.9	<1
Taussig Road	6-24	0.8	1.5
Base 4	7-6	180	140
Borehole 2	7-8	<0.5	<1
M10G(Area 1)	7-16	22.2	22.3
M10G(Area 1)	7-17	13.4	14.0
Base 6	7-20	14.1	59.2
Old St. Charles Rd	7-22	0.3	<1
M10G(Area 1)	7-24	4.6	15.3
M10G(Area 1)	7-28	9.8	60.5
20' W of Borehole #20	7-28	36.4	34.3
Base 8	7-29	0.5	0.5
20' W of Borehole #20	7-30	218	38
000M(Area 1)	7-30	2.9	3
000M(Area 1)	7-31	5.8	0.2

Working Level (WL) and Long-Lived Gross Alpha Activity
on High Volume Air Samples

Table 10

Sample Duration: 10 min.
Flow Rate: 570 l/min.
Total Volume: 1.4E6 ml

Date/Time	Location	7 Day Activity	WL
		uCi/cc	
8105010805	Outside Trailer	2.03E-13+/-122%	.0016
8105010819	Outside Trailer	2.66E-13+/-103%	.0015
8105010918	Base 3	0+/-211%	.0010
8105010931	Base 1	3.13E-13+/-93%	.0008
8105040942	Outside Trailer	4.69E-14+/-365%	.0010
8105041013	Base 1	1.09E-13+/-188%	.0009
8105041124	COOG	4.69E-14+/-365%	.0012
8105041150	Base 4	2.66E-13+/-103%	.0016
8105111034	Earth City Background	4.69E-14+/-365%	.0003
8105121046	Earth City Background	4.69E-14+/-365%	.0004
8105121402	Outside Trailer	0+/-211%	.0002
8105121447	Base 4	4.22E-13+/-78%	.0006
8105121504	Outside W-L Office Bldg	7.34E-13+/-57%	.0003
8105121528	Base 1	1.56E-13+/-145%	.0002
8105121551	TOOP	4.69E-14+/-365%	.0003
8105131154	ZOON	4.69E-14+/-365%	.0010
8105151010	Base 6	2.03E-13+/-122%	.0003
8105151035	Base 7	1.09E-13+/-188%	.0002
8105181022	Base 6	2.03E-13+/-122%	.0003
8105201107	Base 4	2.66E-13+/-103%	.0004
8105201137	Base 6	2.66E-13+/-103%	.0004
8105270821	Inside Trailer	1.41E-12+/-40%	.0110
8105271040	Base 6	7.81E-13+/-55%	.0002
8106021429	OOOJ	2.03E-13+/-122%	.0007
8106021450	hOOO	4.69E-14+/-365%	.0007
8106080957	Drilling Borehole #1	1.56E-13+/-146%	.0006
8106081335	Drilling Borehole #2	4.69E-14+/-365%	.0005
8106091015	Drilling Borehole #3	7.34E-13+/-57%	.0009
8106091318	Drilling Borehole #4	1.15E-11+/-14%	.0020
8106091350	Drilling Borehole #4	8.55E-12+/-16%	.0027

Table 10, cont.

Date/Time	Location	7 Day Activity	WL
		uCi/cc	
8106100945	Drilling Borehole #5	2.66E-13+/-103%	.0012
8106101231	Drilling Borehole #7	4.22E-13+/-78%	.0015
8106101411	Drilling Borehole #8	4.22E-13+/-78%	.0012
8106231028	Earth City Background	1.09E-13+/-188%	.0005
8106231146	Inside Shuman	1.98E-12+/-33%	.0011
8106231407	Taussig Rd Background	4.69E-14+/-365%	.0005
8106300931	Borehole #32	4.69E-14+/-365%	.0006
8107070919	Old St. Charles Rd Bkg	0+/-211%	.0017
8011130845	Area 1, Near Road	--------------	.017
8011131030	Area 1 Highest Ext. Level	--------------	.014
8011131445	Area 2 Highest Ext. Level	--------------	.019
8011131507	Area 2 Suspected Surface Mat.	--------------	.038
8011140735	Inside Shuman Building	--------------	.031

		Isotopic Activities	
Date/Time	Location	U-238	Ra-226
Composite Sample	All Onsite Samples	9.1E-14+/-1%	4.3E-14+/-1%

Note: Individual sample sensitivities are low due to short sampling time. However, all gross alpha activities except two are less than the maximum permissible concentrations (MPCs) for U-238 or Ra-226, for unrestricted areas, as listed in Appendix B, Table II, of 10CFR20. (These MPCs are 3.0E-12 uCi/cc for either nuclide.) The two exceptions occurred when drilling through contaminated materials.

Gamma Analysis of High Volume Air Samples for Rn-219 Daughters (Pb-211)

Table 11

			---Sample Activity (uCi/cc) at---			
Date	Time	Location	405 KeV (3.4% ab)	427 KeV (1.8% ab)	832 KeV (3.4% ab)	Average uCi/cc
6/3	14:21	Base 4 (Area 2, i00P)	2.3E-10	---------	2.5E-10	2.4E-10
6/4	8:31	Base 1 (Area 2, 000J)	5.7E-11	---------	---------	5.7E-11
6/4	12:30	Base 4	1.0E-9	8.9E-10	9.3E-10	9.5E-10
6/18	14:00	Base 4	5.6E-10	4.8E-10	4.6E-10	5.0E-10
6/29	12:23	Base 6 (Area 1, N00A)	9.0E-11	---------	1.3E-10	1.1E-10

Table 12: Priority Pollutant Analyses of Auger Hole and Leachate Sludge Samples

Results of Chemical Analyses of
West Lake Landfill
7 July 1981

Parameter	Units	WTP *	BH-2 *	BH-13 *	BH-25 *	BH-31 *	BH-35 *
Antimony	mg/kg	0.077	0.268	0.325	0.355	0.218	21.0
Arsenic	mg/kg	0.62	6.0	7.0	2.0	4.0	1.0
Beryllium	mg/kg	0.038	0.12	0.24	0.18	0.20	0.14
Cadmium	mg/kg	0.052	2.2	2.3	2.27	4.0	37.5
Chromium	mg/kg	1.41	40.9	34	7.0	26.2	215
Copper	mg/kg	0.459	1039	88	23.2	131.6	356
Cyanide	mg/kg	0.10	0.028	0.12	1.61	0.376	0.97
Lead	mg/kg	19.7	356	431	49.0	251.6	1490
Mercury	mg/kg	5	0.22	0.36	0.14	0.10	0.84
Nickel	mg/kg	3.00	20.0	45.1	11.3	4	218.0
Selenium	mg/kg	0.12	1.6	1.2	1.2	1.2	0.9
Silver	mg/kg	0.134	0.580	0.369	0.165	0.264	0.409
Thallium	mg/kg	14.0	10.0	2.0	<0.1	0.6	3.5
Zinc	mg/kg	41.4	246	270	180	89	2395

* WTP - Waste treatment plant leachate sludge
BH-2 - Auger hole 2, Area 2
BH-13 - Auger hole 13, Area 2
BH-25 - Auger hole 25, Area 1
BH-31 - Auger hole 31, Area 2
BH-35 - Auger hole 35, Area 2

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. W.T.P. (NPDES) DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #569 DATE ANALYSIS COMPLETED 16 July 1981

ACID COMPOUNDS

	µg/l
2,4,6-trichlorophenol	ND
o-chloro-m-cresol	ND
2-chlorophenol	ND
2,4-dichlorophenol	ND
2,4-dimethylphenol	ND
2-nitrophenol	ND
4-nitrophenol	*
2,4-dinitrophenol	*
4,6-dinitro-o-cresol	ND
pentachlorophenol	ND
phenol	8.1

ND - Less than 1 µg/l
* - Less than 25 µg/l
** - Less than 250 µg/l

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. W.T.P. (NPDES) DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #569 DATA ANALYSIS COMPLETED 22 July 1981

BASE/NEUTRAL COMPOUNDS

	µg/l		µg/l
acenaphthene	ND	nitrobenzene	ND
benzidine	**	N-nitrosodimethylamine	**
1,2,4-trichlorobenzene	ND	N-nitrosodiphenylamine	**
hexachlorobenzene	ND	N-nitrosodi-n-propylamine	**
hexachloroethane	ND	bis(2-ethylhexyl)phthalate	*
bis(2-chloroethyl)ether	ND	butyl benzyl phthalate	ND
2-chloronaphthalene	ND	di-n-butyl phthalate	ND
1,2-dichlorobenzene	ND	di-n-octyl phthalate	ND
1,3-dichlorobenzene	ND	diethyl phthalate	ND
1,4-dichlorobenzene	ND	dimethyl phthalate	ND
3,3'-dichlorobenzidine	*	benzo(a)anthracene	ND
2,4-dinitrotoluene	**	benzo(a)pyrene	ND
2,6-dinitrotoluene	*	benzo(b)fluoranthene[1]	ND
1,2-diphenylhydrazine	ND	benzo(k)fluoranthene[1]	ND
fluoranthene	ND	chrysene	ND
4-chlorophenyl phenyl ether	ND	acenaphthylene	ND
4-bromophenyl phenyl ether	ND	anthracene	ND
bis(2-chloroisopropyl)ether	*	benzo (g.h.i.) perylene	*
bis(2-chloroethoxy)methane	ND	fluorene	ND
hexachlorobutadiene	ND	phenanthrene	ND
hexachlorocyclopentadiene	*	dibenzo (a,h)anthracene	*
isophorone	ND	indeno(1,2,3-c,d)pyrene	ND
naphthalene'	ND	pyrene	ND
bis(chloromethyl)ether	**	2,3,7,8-tetrachlorodibenzo-p-dioxin	**

ND - Less than 1 µg/l
* - Less than 10 µg/l
** - Less than 25 µg/l

[1] Benzo(b)fluoranthene and benzo(k)fluoranthene could not be resolved, values reported indicate the sum of both compounds.

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. W.T.P. (NPDES) DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #569 DATE ANALYSIS COMPLETED 24 July 1981

PESTICIDES

	μg/l		μg/l
aldrin	ND	a-BHC	ND
dieldrin	ND	b-BHC	ND
chlordane	ND	d-BHC	*
4,4'-DDT	ND	g-BHC	ND
4,4'-DDE	ND	PCB - 1242	ND
4,4'-DDD	ND	PCB - 1254	ND
endosulfan I	*	PCB - 1221	ND
endosulfan II	*	PCB - 1232	ND
endosulfan sulfate	*	PCB - 1248	ND
endrin	*	PCB - 1260	ND
endrin aldehyde	*	PCB - 1016	ND
heptachlor	ND	toxaphene	ND
heptachlor epoxide	*		

ND - Less than 1 μg/l
 * - Less than 10 μg/l

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. W.T.P. (NPDES) DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #569 DATE ANALYSIS COMPLETED 5 August 1981

VOLATILES

	µg/l		µg/l
acrolein	**	1,2-dichloropropane	ND
acrylonitrile	**	1,3-dichloropropylene[1]	*
benzene	2.0	ethylbenzene	ND
carbon tetrachloride	*	methylene chloride	15.6
chlorobenzene	ND	methyl chloride	*
1,2-dichloroethane	ND	methyl bromide	*
1,1,1-trichloroethane	ND	bromoform	ND
1,1-dichloroethane	ND	dichlorobromomethane	ND
1,1,2-trichloroethane	ND	trichlorofluoromethane	2.3
1,1,2,2-tetrachloroethane	ND	dichlorodifluoromethane	*
chloroethane	*	chlorodibromomethane	ND
2-chloroethylvinyl ether	*	tetrachloroethylene	ND
chloroform	4.3	toluene	1.8
1,1-dichloroethylene	ND	trichloroethylene	ND
1,2-trans-dichloroethylene	*	vinyl chloride	*

ND - Less than 1 µg/l
* - Less than 10 µg/l
** - Less than 100 µg/l

[1] 1,3-cis-dichloropropylene and 1,3-trans-dichloropropylene could not be resolved, values reported indicate the sum of both compounds.

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. BH-2 (NPDES) DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #570 DATE ANALYSIS COMPLETED 16 July 1981

ACID COMPOUNDS

	µg/l
2,4,6-trichlorophenol	ND
o-chloro-m-cresol	ND
2-chlorophenol	ND
2,4-dichlorophenol	ND
2,4-dimethylphenol	ND
2-nitrophenol	ND
4-nitrophenol	*
2,4-dinitrophenol	*
4,6-dinitro-o-cresol	ND
pentachlorophenol	ND
phenol	7.8

ND - Less than 1 µg/l
* - Less than 25 µg/l
** - Less than 250 µg/l

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. BH-2 (NPDES) DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #570 DATA ANALYSIS COMPLETED 22 July 1981

BASE/NEUTRAL COMPOUNDS

Compound	μg/l	Compound	μg/l
acenaphthene	ND	nitrobenzene	
benzidine	**	N-nitrosodimethylamine	
1,2,4-trichlorobenzene	ND	N-nitrosodiphenylamine	
hexachlorobenzene	ND	N-nitrosodi-n-propylamine	
hexachloroethane	ND	bis(2-ethylhexyl)phthalate	
bis(2-chloroethyl)ether	ND	butyl benzyl phthalate	
2-chloronaphthalene	ND	di-n-butyl phthalate	
1,2-dichlorobenzene	ND	di-n-octyl phthalate	
1,3-dichlorobenzene	ND	diethyl phthalate	
1,4-dichlorobenzene	ND	dimethyl phthalate	
3,3'-dichlorobenzidine	*	benzo(a)anthracene	
2,4-dinitrotoluene	**	benzo(a)pyrene	
2,6-dinitrotoluene	ND	benzo(b)fluoranthene[1]	
1,2-diphenylhydrazine	ND	benzo(k)fluoranthene[1]	
fluoranthene	ND	chrysene	
4-chlorophenyl phenyl ether	ND	acenaphthylene	
4-bromophenyl phenyl ether	ND	anthracene	
bis(2-chloroisopropyl)ether	ND	benzo (g.h.i.) perylene	
bis(2-chloroethoxy)methane	ND	fluorene	
hexachlorobutadiene	ND	phenanthrene	
hexachlorocyclopentadiene	*	dibenzo (a,h)anthracene	
isophorone	ND	indeno(1,2,3-c,d)pyrene	
naphthalene'	ND	pyrene	
bis(chloromethyl)ether	**	2,3,7,8-tetrachlorodibenzo-p-dioxin	

ND - Less than 1 μg/l
* - Less than 10 μg/l
** - Less than 25 μg/l

[1] Benzo(b)fluoranthene and benzo(k)fluoranthene could not be resolved, values reported indicate the sum of both compounds.

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. BH-2 (NPDES) DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #570 DATE ANALYSIS COMPLETED 24 July 1981

PESTICIDES

	μg/l		μg/l
aldrin	*	a-BHC	*
dieldrin	ND	b-BHC	ND
chlordane	ND	d-BHC	*
4,4'-DDT	ND	g-BHC	ND
4,4'-DDE	ND	PCB - 1242	ND
4,4'-DDD	ND	PCB - 1254	ND
endosulfan I	*	PCB - 1221	ND
endosulfan II	*	PCB - 1232	ND
endosulfan sulfate	*	PCB - 1248	ND
endrin	*	PCB - 1260	ND
endrin aldehyde	*	PCB - 1016	ND
heptachlor	ND	toxaphene	ND
heptachlor epoxide	*		

ND - Less than 1 μg/l
* - Less than 10 μg/l

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. BH-2 (NPDES) DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #570 DATE ANALYSIS COMPLETED 5 August 1981

VOLATILES

	µg/l		µg/l
acrolein	**	1,2-dichloropropane	ND
acrylonitrile	**	1,3-dichloropropylene[1]	*
benzene	1.4	ethylbenzene	1.2
carbon tetrachloride	*	methylene chloride	21.4
chlorobenzene	1.9	methyl chloride	*
1,2-dichloroethane	7.1	methyl bromide	13.1
1,1,1-trichloroethane	ND	bromoform	ND
1,1-dichloroethane	ND	dichlorobromomethane	ND
1,1,2-trichloroethane	ND	trichlorofluoromethane	2.4
1,1,2,2-tetrachloroethane	ND	dichlorodifluoromethane	*
chloroethane	*	chlorodibromomethane	ND
2-chloroethylvinyl ether	ND	tetrachloroethylene	1.7
chloroform	6.2	toluene	7.3
1,1-dichloroethylene	ND	trichloroethylene	1.7
1,2-trans-dichloroethylene	3.4	vinyl chloride	*

ND - Less than 1 µg/kg
* - Less than 10 µg/kg
** - Less than 100 µg/kg

[1] 1,3-cis-dichloropropylene and 1,3-trans-dichloropropylene could not be resolved, Values reported indicate the sum of both compounds.

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. BH-13 (NPDES) DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #571 DATE ANALYSIS COMPLETED 16 July 1981

ACID COMPOUNDS

	µg/l
2,4,6-trichlorophenol	ND
o-chloro-m-cresol	ND
2-chlorophenol	ND
2,4-dichlorophenol	ND
2,4-dimethylphenol	ND
2-nitrophenol	ND
4-nitrophenol	*
2,4-dinitrophenol	ND
4,6-dinitro-o-cresol	ND
pentachlorophenol	ND
phenol	2.6

ND - Less than 1 µg/l
* - Less than 25 µg/l
** - Less than 250 µg/l

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. BH-13 (NPDES) DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #571 DATA ANALYSIS COMPLETED 22 July 1981

BASE/NEUTRAL COMPOUNDS

	μg/l		μg/l
acenaphthene	ND	nitrobenzene	ND
benzidine	**	N-nitrosodimethylamine	**
1,2,4-trichlorobenzene	ND	N-nitrosodiphenylamine	**
hexachlorobenzene	ND	N-nitrosodi-n-propylamine	**
hexachloroethane	*	bis(2-ethylhexyl)phthalate	10.1
bis(2-chloroethyl)ether	*	butyl benzyl phthalate	*
2-chloronaphthalene	ND	di-n-butyl phthalate	ND
1,2-dichlorobenzene	ND	di-n-octyl phthalate	ND
1,3-dichlorobenzene	ND	diethyl phthalate	ND
1,4-dichlorobenzene	ND	dimethyl phthalate	ND
3,3'-dichlorobenzidine	*	benzo(a)anthracene	ND
2,4-dinitrotoluene	**	benzo(a)pyrene	*
2,6-dinitrotoluene	*	benzo(b)fluoranthene[1]	*
1,2-diphenylhydrazine	*	benzo(k)fluoranthene[1]	*
fluoranthene	ND	chrysene	*
4-chlorophenyl phenyl ether	*	acenaphthylene	ND
4-bromophenyl phenyl ether	*	anthracene	ND
bis(2-chloroisopropyl)ether	*	benzo (g.h.i.) perylene	**
bis(2-chloroethoxy)methane	*	fluorene	ND
hexachlorobutadiene	*	phenanthrene	ND
hexachlorocyclopentadiene	*	dibenzo (a,h)anthracene	**
isophorone	*	indeno(1,2,3-c,d)pyrene	*
naphthalene'	ND	pyrene	ND
bis(chloromethyl)ether	**	2,3,7,8-tetrachlorodibenzo-p-dioxin	**

ND - Less than 1 μg/l
* - less than 10 μg/l
** - Less than 25 μg/l

[1]Benzo(b)fluoranthene and benzo(k)fluoranthene could not be resolved, values reported indicate the sum of both compounds.

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. BH-13 (NPDES) DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #571 DATE ANALYSIS COMPLETED 24 July 1981

PESTICIDES

	µg/l		µg/l
aldrin	*	a-BHC	*
dieldrin	*	b-BHC	*
chlordane	ND	d-BHC	*
4,4'-DDT	*	g-BHC	*
4,4'-DDE	*	PCB - 1242	ND
4,4'-DDD	*	PCB - 1254	ND
endosulfan I	*	PCB - 1221	ND
endosulfan II	*	PCB - 1232	ND
endosulfan sulfate	*	PCB - 1248	ND
endrin	*	PCB - 1260	ND
endrin aldehyde	*	PCB - 1016	ND
heptachlor	*	toxaphene	ND
heptachlor epoxide	*		

ND - Less than 1 µg/l
* - Less than 10 µg/l

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. BH-13 (NPDES) DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #571 DATE ANALYSIS COMPLETED 5 August 1981

VOLATILES

	µg/l		µg/l
acrolein	**	1,2-dichloropropane	ND
acrylonitrile	**	1,3-dichloropropylene[1]	*
benzene	ND	ethylbenzene	4.4
carbon tetrachloride	*	methylene chloride	ND
chlorobenzene	ND	methyl chloride	*
1,2-dichloroethane	ND	methyl bromide	*
1,1,1-trichloroethane	ND	bromoform	ND
1,1-dichloroethane	ND	dichlorobromomethane	ND
1,1,2-trichloroethane	ND	trichlorofluoromethane	33.8
1,1,2,2-tetrachloroethane	ND	dichlorodifluoromethane	*
chloroethane	*	chlorodibromomethane	ND
2-chloroethylvinyl ether	ND	tetrachloroethylene	4.6
chloroform	7.8	toluene	ND
1,1-dichloroethylene	ND	trichloroethylene	1.8
1,2-trans-dichloroethylene	ND	vinyl chloride	*

ND - Less than 1 µg/kg
* - Less than 10 µg/kg
** - Less than 100 µg/kg

[1] 1,3-cis-dichloropropylene and 1,3-trans-dichloropropylene could not be resolved, values reported indicate the sum of both compounds.

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. BH-25 (NPDES) DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #572 DATE ANALYSIS COMPLETED 16 July 1981

ACID COMPOUNDS

	µg/l
2,4,6-trichlorophenol	ND
o-chloro-m-cresol	ND
2-chlorophenol	ND
2,4-dichlorophenol	ND
2,4-dimethylphenol	ND
2-nitrophenol	ND
4-nitrophenol	*
2,4-dinitrophenol	**
4,6-dinitro-o-cresol	*
pentachlorophenol	ND
phenol	52.8

ND - Less than 1 µg/l
* - Less than 25 µg/l
** - Less than 250 µg/l

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. BH-25 (NPDES) DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #572 DATA ANALYSIS COMPLETED [illegible] July 1981

BASE/NEUTRAL COMPOUNDS

	µg/l		µg/l
acenaphthene	ND	nitrobenzene	*
benzidine	**	N-nitrosodimethylamine	**
1,2,4-trichlorobenzene	ND	N-nitrosodiphenylamine	**
hexachlorobenzene	ND	N-nitrosodi-n-propylamine	**
hexachloroethane	*	bis(2-ethylhexyl)phthalate	3.5
bis(2-chloroethyl)ether	*	butyl benzyl phthalate	*
2-chloronaphthalene	ND	di-n-butyl phthalate	ND
1,2-dichlorobenzene	ND	di-n-octyl phthalate	ND
1,3-dichlorobenzene	ND	diethyl phthalate	ND
1,4-dichlorobenzene	ND	dimethyl phthalate	ND
3,3'-dichlorobenzidine	*	benzo(a)anthracene	ND
2,4-dinitrotoluene	**	benzo(a)pyrene	*
2,6-dinitrotoluene	*	benzo(b)fluoranthene[1]	*
1,2-diphenylhydrazine	ND	benzo(k)fluoranthene[1]	*
fluoranthene	ND	chrysene	ND
4-chlorophenyl phenyl ether	*	acenaphthylene	ND
4-bromophenyl phenyl ether	*	anthracene	ND
bis(2-chloroisopropyl)ether	*	benzo (g.h.i.) perylene	*
bis(2-chloroethoxy)methane	*	fluorene	ND
hexachlorobutadiene	*	phenanthrene	ND
hexachlorocyclopentadiene	*	dibenzo (a,h)anthracene	**
isophorone	*	indeno(1,2,3-c,d)pyrene	*
naphthalene'	ND	pyrene	ND
bis(chloromethyl)ether	**	2,3,7,8-tetrachlorodibenzo-p-dioxin	**

ND - Less than 1 µg/l
* - Less than 10 µg/l
** - Less than 25 µg/l

[1] Benzo(b)fluoranthene and benzo(k)fluoranthene could not be resolved, values reported indicate the sum of both compounds.

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. BH-25 (NPDES) DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #572 DATE ANALYSIS COMPLETED 24 July 1981

PESTICIDES

	μg/l		μg/l
aldrin	*	a-BHC	*
dieldrin	ND	b-BHC	ND
chlordane	ND	d-BHC	*
4,4'-DDT	ND	g-BHC	ND
4,4'-DDE	ND	PCB - 1242	ND
4,4'-DDD	ND	PCB - 1254	ND
endosulfan I	*	PCB - 1221	ND
endosulfan II	*	PCB - 1232	ND
endosulfan sulfate	*	PCB - 1248	ND
endrin	*	PCB - 1260	ND
endrin aldehyde	*	PCB - 1016	ND
heptachlor	ND	toxaphene	ND
heptachlor epoxide	*		

ND - Less than 1 μg/l
* - Less than 10 μg/l

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. BH-25 (NPDES) DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #572 DATE ANALYSIS COMPLETED 5 August 1981

VOLATILES

	µg/l		µg/l
acrolein	**	1,2-dichloropropane	ND
acrylonitrile	**	1,3-dichloropropylene[1]	*
benzene	1.1	ethylbenzene	21.3
carbon tetrachloride	*	methylene chloride	11.4
chlorobenzene	ND	methyl chloride	*
1,2-dichloroethane	5.4	methyl bromide	*
1,1,1-trichloroethane	ND	bromoform	ND
1,1-dichloroethane	ND	dichlorobromomethane	ND
1,1,2-trichloroethane	ND	trichlorofluoromethane	*
1,1,2,2-tetrachloroethane	ND	dichlorodifluoromethane	*
chloroethane	*	chlorodibromomethane	ND
2-chloroethylvinyl ether	ND	tetrachloroethylene	48.4
chloroform	ND	toluene	45.3
1,1-dichloroethylene	*	trichloroethylene	4.4
1,2-trans-dichloroethylene	23.1	vinyl chloride	*

ND - Less than 1 µg/kg
* - Less than 10 µg/kg
** - Less than 100 µg/kg

[1] 1,3-cis-dichloropropylene and 1,3-trans-dichloropropylene could not be resolved, values reported indicate the sum of both compounds.

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. BH-31 (NPDES) DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #573 DATE ANALYSIS COMPLETED 16 July 1981

ACID COMPOUNDS

	μg/l
2,4,6-trichlorophenol	*
o-chloro-m-cresol	ND
2-chlorophenol	26.0
2,4-dichlorophenol	ND
2,4-dimethylphenol	ND
2-nitrophenol	ND
4-nitrophenol	*
2,4-dinitrophenol	*
4,6-dinitro-o-cresol	ND
pentachlorophenol	ND
phenol	2.6

ND - Less than 1 μg/l
* - Less than 25 μg/l
** - Less than 250 μg/l

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. BH-31 (NPDES) DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #573 DATA ANALYSIS COMPLETED 22 July 1981

BASE/NEUTRAL COMPOUNDS

	µg/l		µg/l
acenaphthene	ND	nitrobenzene	ND
benzidine	**	N-nitrosodimethylamine	**
1,2,4-trichlorobenzene	ND	N-nitrosodiphenylamine	**
hexachlorobenzene	ND	N-nitrosodi-n-propylamine	**
hexachloroethane	ND	bis(2-ethylhexyl)phthalate	*
bis(2-chloroethyl)ether	ND	butyl benzyl phthalate	16.2
2-chloronaphthalene	ND	di-n-butyl phthalate	ND
1,2-dichlorobenzene	ND	di-n-octyl phthalate	1.4
1,3-dichlorobenzene	ND	diethyl phthalate	ND
1,4-dichlorobenzene	ND	dimethyl phthalate	ND
3,3'-dichlorobenzidine	*	benzo(a)anthracene	ND
2,4-dinitrotoluene	**	benzo(a)pyrene	ND
2,6-dinitrotoluene	ND	benzo(b)fluoranthene[1]	ND
1,2-diphenylhydrazine	ND	benzo(k)fluoranthene[1]	ND
fluoranthene	ND	chrysene	ND
4-chlorophenyl phenyl ether	ND	acenaphthylene	ND
4-bromophenyl phenyl ether	ND	anthracene	ND
bis(2-chloroisopropyl)ether	ND	benzo (g.h.i.) perylene	*
bis(2-chloroethoxy)methane	ND	fluorene	ND
hexachlorobutadiene	ND	phenanthrene	ND
hexachlorocyclopentadiene	*	dibenzo (a,h)anthracene	*
isophorone	ND	indeno(1,2,3-c,d)pyrene	ND
naphthalene'	ND	pyrene	ND
bis(chloromethyl)ether	**	2,3,7,8-tetrachlorodibenzo-p-dioxin	**

ND - Less than 1 µg/l
* - Less than 10 µg/l
** - Less than 25 µg/l

[1] Benzo(b)fluoranthene and benzo(k)fluoranthene could not be resolved, values reported indicate the sum of both compounds.

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. BH-31 (NPDES) DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #573 DATE ANALYSIS COMPLETED 24 July 1981

PESTICIDES

	µg/l		µg/l
aldrin	ND	a-BHC	*
dieldrin	ND	b-BHC	ND
chlordane	ND	d-BHC	8.5
4,4'-DDT	ND	g-BHC	ND
4,4'-DDE	ND	PCB - 1242	ND
4,4'-DDD	ND	PCB - 1254	ND
endosulfan I	*	PCB - 1221	ND
endosulfan II	*	PCB - 1232	ND
endosulfan sulfate	*	PCB - 1248	ND
endrin	*	PCB - 1260	ND
endrin aldehyde	*	PCB - 1016	ND
heptachlor	ND	toxaphene	ND
heptachlor epoxide	*		

ND - Less than 1 µg/l
* - Less than 10 µg/l

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. BH-31 (NPDES) DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #573 DATE ANALYSIS COMPLETED 5 August 1981

VOLATILES

	µg/l		µg/l
acrolein	**	1,2-dichloropropane	ND
acrylonitrile	**	1,3-dichloropropylene[1]	*
benzene	ND	ethylbenzene	30.4
carbon tetrachloride	*	methylene chloride	1.4
chlorobenzene	9.6	methyl chloride	*
1,2-dichloroethane	4.2	methyl bromide	*
1,1,1-trichloroethane	1.4	bromoform	ND
1,1-dichloroethane	ND	dichlorobromomethane	ND
1,1,2-trichloroethane	ND	trichlorofluoromethane	2.6
1,1,2,2-tetrachloroethane	ND	dichlorodifluoromethane	*
chloroethane	*	chlorodibromomethane	ND
2-chloroethylvinyl ether	ND	tetrachloroethylene	19.3
chloroform	3.1	toluene	30.9
1,1-dichloroethylene	ND	trichloroethylene	13.1
1,2-trans-dichloroethylene	40.2	vinyl chloride	*

ND - Less than 1 µg/kg
* - Less than 10 µg/kg
** - Less than 100 µg/kg

[1] 1,3-cis-dichloropropylene and 1,3-trans-dichloropropylene could not be resolved, values reported indicate the sum of both compounds.

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. BH-35 DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #574 DATE ANALYSIS COMPLETED 16 July 1981

ACID COMPOUNDS

	µg/l
2,4,6-trichlorophenol	*
o-chloro-m-cresol	ND
2-chlorophenol	1414.7
2,4-dichlorophenol	ND
2,4-dimethylphenol	ND
2-nitrophenol	ND
4-nitrophenol	*
2,4-dinitrophenol	**
4,6-dinitro-o-cresol	*
pentachlorophenol	*
phenol	159.0

ND - Less than 1 µg/l
* - Less than 25 µg/l
** - Less than 250 µg/l

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. BH-35 (NPDES) DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #574 DATA ANALYSIS COMPLETED 22 July 1981

BASE/NEUTRAL COMPOUNDS

	µg/l		µg/l
acenaphthene	ND	nitrobenzene	*
benzidine	**	N-nitrosodimethylamine	**
1,2,4-trichlorobenzene	ND	N-nitrosodiphenylamine	**
hexachlorobenzene	ND	N-nitrosodi-n-propylamine	**
hexachloroethane	ND	bis(2-ethylhexyl)phthalate	**
bis(2-chloroethyl)ether	ND	butyl benzyl phthalate	18.4
2-chloronaphthalene	ND	di-n-butyl phthalate	*
1,2-dichlorobenzene	ND	di-n-octyl phthalate	ND
1,3-dichlorobenzene	ND	diethyl phthalate	ND
1,4-dichlorobenzene	ND	dimethyl phthalate	ND
3,3'-dichlorobenzidine	*	benzo(a)anthracene	ND
2,4-dinitrotoluene	**	benzo(a)pyrene	ND
2,6-dinitrotoluene	*	benzo(b)fluoranthene[1]	ND
1,2-diphenylhydrazine	ND	benzo(k)fluoranthene[1]	ND
fluoranthene	ND	chrysene	ND
4-chlorophenyl phenyl ether	ND	acenaphthylene	ND
4-bromophenyl phenyl ether	ND	anthracene	ND
bis(2-chloroisopropyl)ether	ND	benzo (g.h.i.) perylene	*
bis(2-chloroethoxy)methane	ND	fluorene	ND
hexachlorobutadiene	ND	phenanthrene	ND
hexachlorocyclopentadiene	*	dibenzo (a,h)anthracene	*
isophorone	ND	indeno(1,2,3-c,d)pyrene	ND
naphthalene'	3.8	pyrene	ND
bis(chloromethyl)ether	**	2,3,7,8-tetrachlorodibenzo-p-dioxin	**

ND - Less than 1 µg/l
* - Less than 10 µg/l
** - Less than 25 µg/l

[1] Benzo(b)fluoranthene and benzo(k)fluoranthene could not be resolved, values reported indicate the sum of both compounds.

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. BH-35 (NPDES) DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #574 DATE ANALYSIS COMPLETED 24 July 1981

PESTICIDES

	µg/l		µg/l
aldrin	*	a-BHC	ND
dieldrin	ND	b-BHC	ND
chlordane	940	d-BHC	*
4,4'-DDT	ND	g-BHC	ND
4,4'-DDE	ND	PCB - 1242	ND
4,4'-DDD	ND	PCB - 1254	ND
endosulfan I	*	PCB - 1221	ND
endosulfan II	*	PCB - 1232	ND
endosulfan sulfate	*	PCB - 1248	ND
endrin	*	PCB - 1260	ND
endrin aldehyde	*	PCB - 1016	ND
heptachlor	ND	toxaphene	ND
heptachlor epoxide	*		

ND - Less than 1 µg/l
* - Less than 10 µg/l

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

CLIENT West Lake

CLIENT I.D. BH-35 DATE SAMPLE RECEIVED 6 July 1981

RMC I.D. #574 DATE ANALYSIS COMPLETED 5 August 1981

VOLATILES

	µg/l		µg/l
acrolein	**	1,2-dichloropropane	ND
acrylonitrile	**	1,3-dichloropropylene[1]	*
benzene	15.7	ethylbenzene	487.9
carbon tetrachloride	22.4	methylene chloride	26.4
chlorobenzene	ND	methyl chloride	*
1,2-dichloroethane	81.6	methyl bromide	57.6
1,1,1-trichloroethane	ND	bromoform	ND
1,1-dichloroethane	18.4	dichlorobromomethane	ND
1,1,2-trichloroethane	ND	trichlorofluoromethane	147.9
1,1,2,2-tetrachloroethane	ND	dichlorodifluoromethane	*
chloroethane	*	chlorodibromomethane	ND
2-chloroethylvinyl ether	*	tetrachloroethylene	45.3
chloroform	25.1	toluene	277.1
1,1-dichloroethylene	5.2	trichloroethylene	724.9
1,2-trans-dichloroethylene	7.7	vinyl chloride	**

ND - Less than 1 µg/kg
* - Less than 10 µg/kg
** - Less than 100 µg/kg

[1] 1,3-cis-dichloropropylene and 1,3-trans-dichloropropylene could not be resolved, values reported indicate the sum of both compounds.

Chemical Analysis of Radioactive Material From Areas 1 and 2

Table 13

Concentration in ppm

	Offsite Bkg Sample	Area 1 Surface (#101)	Area 1 Surface (#102)	Area 1 Borehole (#103)	Area 2 Surface (#104)	Area 2 Surface (#105)
Barium	250	300	1811	2386	1158	1197
Lead	16	15	108	121	11	50
Zinc	132	146	94	76	28	167
Sulfate	20	15	108	121	11	50

Summary of Background Measurements in the Vicinity of West Lake Landfill,
St. Louis County Missouri

Table 14

Sample Type	Background Location		
	Earth City	Taussig Road	Old St. Charles Rock Road
Flux (Av)(pCi/m2.s)	0.50 +/- 54%	0.58 +/- 27%	0.50 +/- 30%
Exposure Rate (uR/hr)	10.6	8.0	--------------
Soil Conc. (Ra-226 pCi/gm)	2.6 +/- 23%	2.5 +/- 19%	--------------
HVAS (W.L.)	1.1E-3	5E-3	1.7E-3

Target Criteria and Measurements LLDs for West Lake Landfill

Table 15

Soil Contaminants

Nuclide	Target Criteria	LLD
Ra-226	5pCi/g	1pCi/g
Total U	15pCi/g	3pCi/g
U-238	30pCi/g	6pCi/g
U-235	30pCi/g	6pCi/g
Th-232	5pCi/g	1pCi/g
Th-230	15pCi/g	3pCi/g

Water and Airborne Contaminants

Nuclide	Target Criteria	LLD
All	MPC Unrestricted	20% MPC
Radon Daughters	0.03 W.L.	0.006 W.L.
Ra-226 (water)	3E-8 uCi/ml	6E-9 uCi/ml

External Radiation

Nuclide	Target Criteria	LLD
All	20 uR/hr	4 uR/hr

APPENDIX I

Radiological Survey Instruments and Methods

A. Portable Survey Instrument

The portable survey instruments used at West Lake included two complete sets of Johnson equipment, which consist of battery operated rate meters, scalers and alpha, beta and gamma probes. These systems (see Figure I-1) are totally portable and can be used in the field for both measurements and sample counting.

The alpha probes use a ZnS (Ag) scintillation detector; the beta detector is a thin window (1.4mg/cm2 mica) GM tube, and the gamma detector is a 2" by 2" NaI(Tl) crystal. The alpha and beta probes were calibrated with "NBS traceable" sources at the RMC calibration facility in Philadelphia and the gamma scintillator was cross-calibrated with a primary ionization chamber system, described below.

B. Ionization Chamber System

External gamma dose rates were accurately measured with the RMC constructed Tissue Equivalent Ionization Chamber System (Figure I-2). This system consisted of a 16 liter tissue equivalent, gas filled ionization chamber (Shonka chamber), a Keithley vibrating capacitor electrometer, a printer and battery pack. It is capable of measuring dose rates at background levels to a precision of a few percent.

Since this system is bulky and somewhat fragile, it is not as suited for extensive field measurements as a smaller, lightweight NaI(Tl) portable survey instrument. Therefore, the NaI(Tl) detector was used for the majority of the field gamma measurements. Since this detector's response is energy dependent, it cannot be used as a "micro R meter" unless it is initially calibrated for such use.

The calibration performed by RMC consisted of accurately measuring the exposure rate at several locations at West Lake Landfill, using the Tissue Equivalent Ionization Chamber, then recording NaI(Tl) measurements at the same location. In this manner a set of NaI(Tl) count-rate versus exposure rates were obtained and a uR/hr calibration factor established, as shown in Figure I-3.

Due to the energy dependence of the NaI detector, this conversion factor will apply only to the radionuclides and geometries for which the calibrations were made. In the case of West Lake, analyses have verified the presence only of naturally occurring nuclides of the uranium series (Ra-226 and daughters), thorium series and potassium. Therefore, the conversion factor established at West Lake will apply only to naturally occurring radionuclides distributed in soil.

C. Mobile Lab Gamma Analysis System

The mobile lab gamma analysis system (Figure I-4) consists of a PGT 15% efficient (relative to a 3" x 3" NaI(Tl) crystal) intrinsic germanium (IG) detector, shield and Tennecomp TP-50 laboratory computer data acquisition module. The analysis system was calibrated for all counting geometries with an NBS supplied Eu-152 source.

Each count was analyzed by a computer program for determination of gamma energies and peak areas. All results were printed out immediately following analysis on-site, and data was stored on floppy discs for future analysis, as needed.

Samples were sealed in counting containers and stored to allow for complete ingrowth of radon and daughters, whenever possible. In these cases, Ra-226 was determined by counting the daughter Bi-214 gamma-ray lines at 609 and 1764 KeV. Pb-214 was determined by the 295 and 352 KeV lines, U-238 from its 93 KeV line, Ra-223 from its 270 KeV line, Rn-219 from its 401 KeV line, Pb-211 from its 405 and 832 KeV lines, Th-227 from its 237 KeV line and K-40 from its 1462 KeV line.

Typical LLDs for Ra-226 were 0.1 pCi/g in soil and vegetation, and 0.4 pCi/l in water. For Rn-219 daughters on air filters, LLDs were 0.4 pCi/l. The LLD for U-238 in soil was on the order of 1 pCi/g.

D. Auger Hole Logging System

Detailed logging of selected auger holes was performed with the system shown in Figure I-5. This system consists of a custom designed EG&G Ortec intrinsic germanium detector (10% eff) with a narrow dewar, coupled to a Tracor-Northern

1750 MCA used for data acquisition and initial field evaluations. Data was stored on a tape cassette recorder, then transferred to the lab computer system for final analysis. The entire system, including an NIM module power supply with a bias power supply and amplifier, was powered in the field by a portable 5000 watt gasoline-driven generator.

The logging system was calibrated as described in Attachment 1. Field counting times varied from 2 minutes to 10 minutes at each location, depending upon the level of activity present. Typical LLDs for this system and relatively short count times are 0.3 pCi/g for Bi-214, 1 pCi/g for U-238, 0.2 pCi/g for Pb-212 and 0.1 pCi/g for K-40.

The field use of this system was somewhat limited by initial failure due to high humidity effects on the pre-amp components and thermal insulation of the detector housing. These problems were partially corrected by sealing the detector in an outer container and allowing dry air to flow through the container.

E. Radon Analysis Systems

Radon flux was determined using the accumulator system shown in Figure I-6, which is similar to those used by Wilkening [1] and others. Accumulation times varied from 15 minutes to 2 hours. Gas samples were drawn and counted in the EDA Radon Detector, usually 2 hours after sampling, to allow for daughter ingrowth. Standard MSA charcoal canisters were used for the canister method, as described by Countess [2].

F. Alpha-Beta Counting System.

All samples were counted for gross alpha or beta activity on the Gamma Products low background gas flow proportional counter, shown in Figure I-7. The system is automatic and can be programmed for a variety of counting parameters.

REFERENCES

[1] M. Wilkening, "Measurement of Radon Flux by the Accumulation Method", Workshops on Methods for Measuring Radiation in and Around Uranium Mills, 3, 9, 1977, pp. 131-137.

[2] R. J. Countess, "Measurements of Rn-222 Flux with Charcoal Canisters" ibid. pp. 139-147.

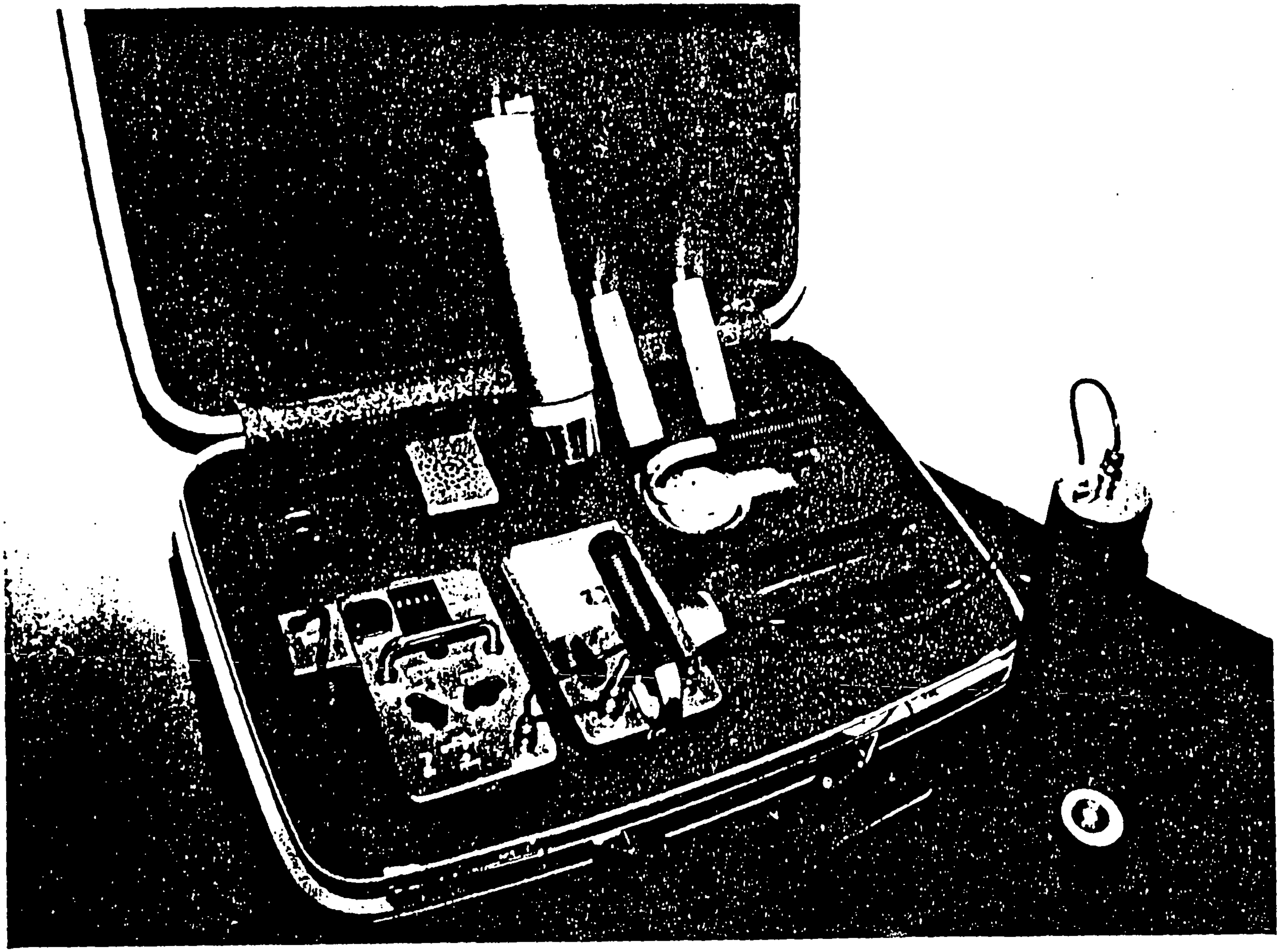


Figure I-1. Portable Survey Instrument Kit.

Landfill site.

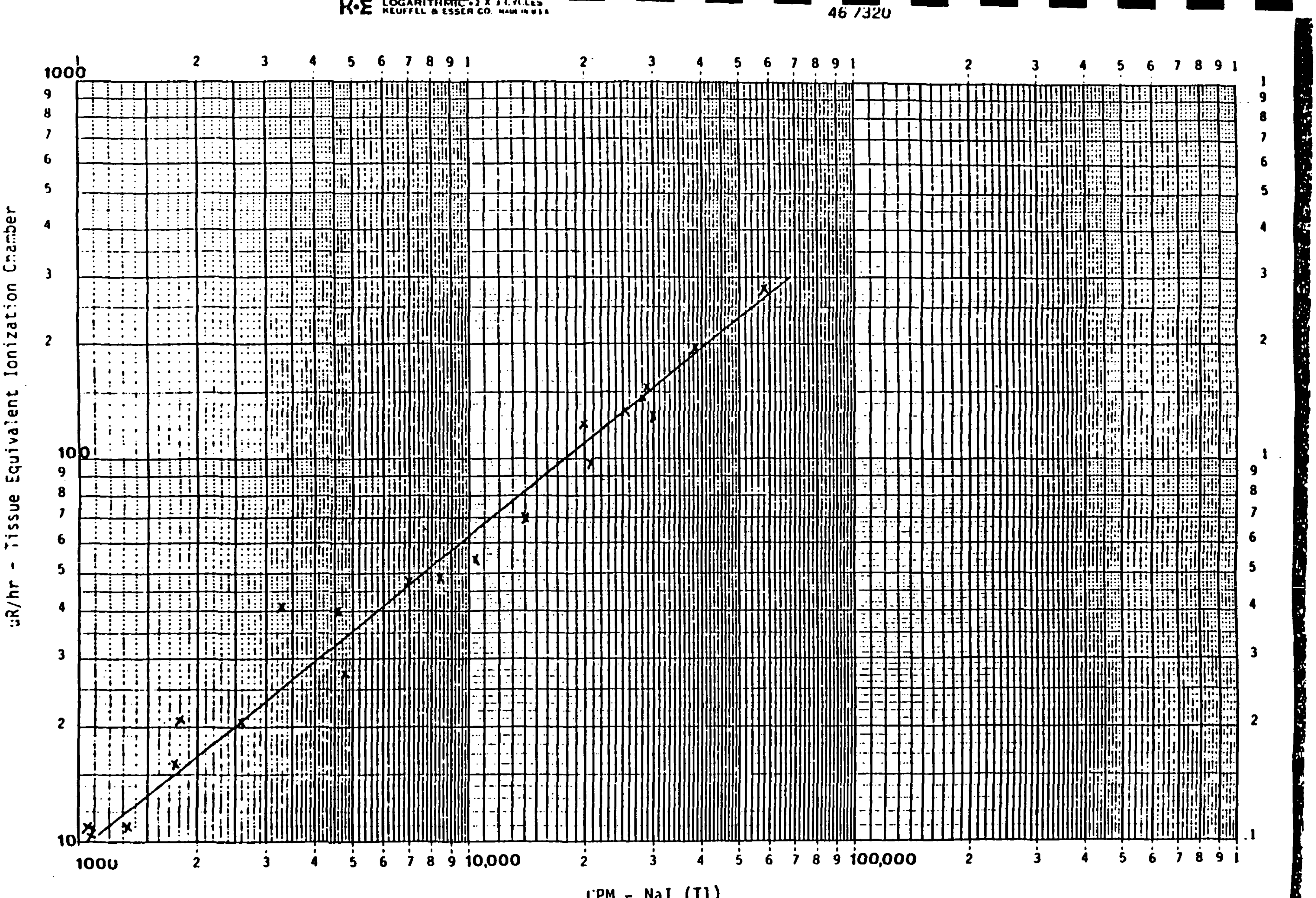


Figure I-3. Ion chamber exposure rates versus NaI (Tl) count rates, West Lake Landfill site.

Figure I-4. Interior of mobile lab showing gamma counting system and other equipment.

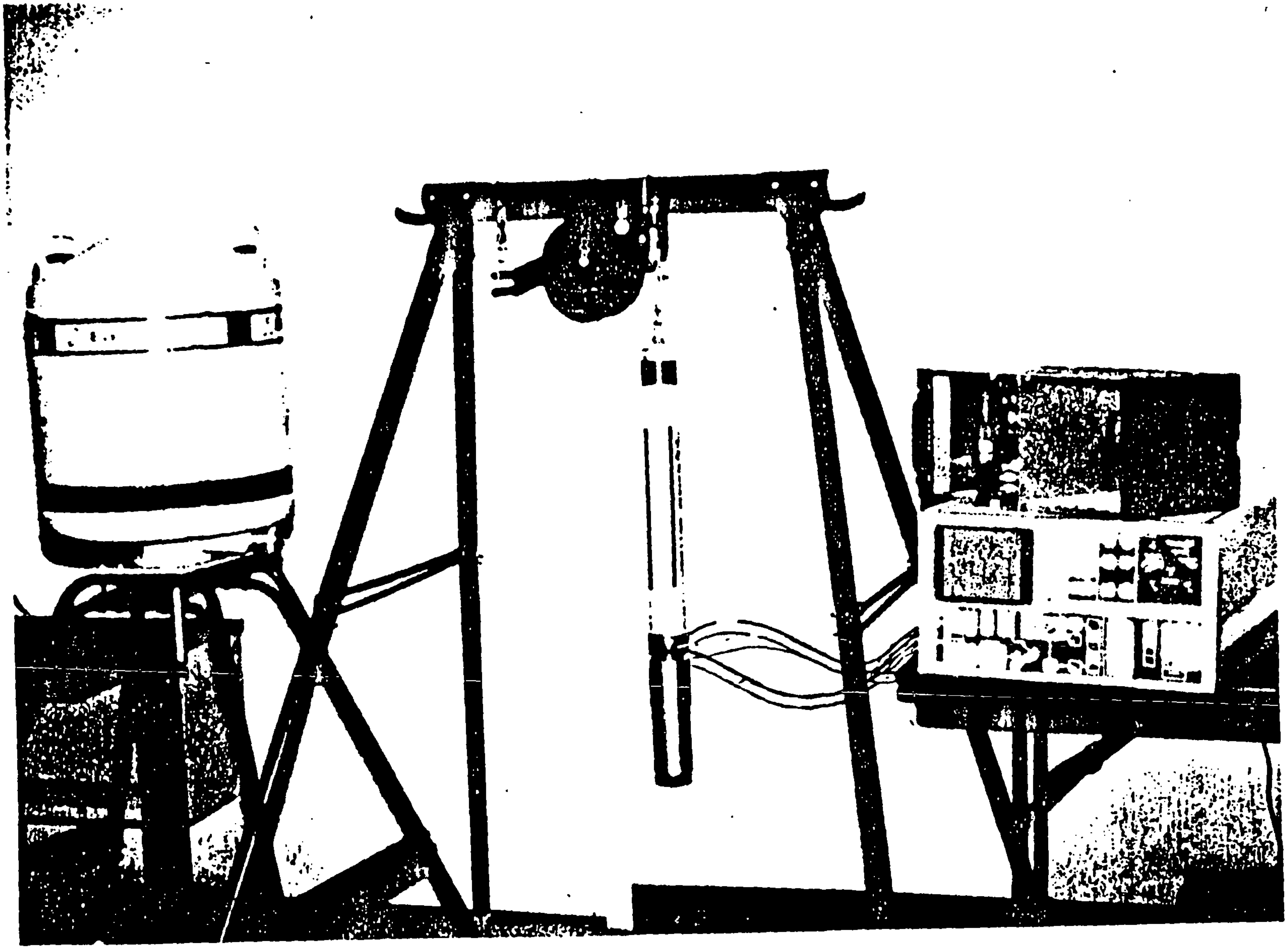


Figure I-5. In-situ auger hole logging system with intrinsic germanium detector and narrow dewar assembly, data acquisition equipment and storage/fill dewar.

Figure I-7. Automatic beta-gamma gas flow proportional counter.

ATTACHMENT 1 TO APPENDIX I

INTRINSIC GERMANIUM WELL LOG
DETECTOR CALIBRATION

The intrinsic germanium detector was connected to the pulse height analysis system consisting of the following components:

Ortec Model 459 High Voltage Power Supply
Canberra 2011 Spectroscopy Amplifier
Tracor Northern 1750 MCA
Teletype Model 43 Printer

Gain and voltage supply settings were adjusted to obtain an energy spectrum of 0 to 2000 kev, which corresponds to approximately 1 kev per channel.

Calibration of the well logging system was performed using the calibration rig shown in Figure 1. This rig is constructed as a series of four concentric rings surrounding a 6 inch PVC casing. Each ring contains thin plastic tubes 1-1/4" diameter by 36" long. A set of "source rods" and "background rods" were prepared and loaded into these tubes in a variety of configurations for the various calibration and test counts.

The geometry of the rig is such that the distance from the center of the casing (or detector) to the center of the innermost ring is 3.75 inches, to the center of the second ring is 5.0 inches, to the center of the third ring is 6.25

inches, and to the center of the fourth ring is 7.50 inches. All voids between tubes were filled with low background sand. It was determined that the ratio of source volume in each ring to the total ring area was about 0.6. Hence, when source rods were fully loaded into a given ring, the activity counted represented approximately 60% of the total area (volume) the detector viewed, and counts were adjusted accordingly.

Each source tube is a 12 inch high by 1 inch diameter tube filled with a material containing Eu-152. The source material was prepared by mixing the standard Eu-152 source solution with plaster of paris, at a constant ratio designed to give a uniform specific activity of 440 pCi/gram. Background rods were filled with "clean" plaster of paris. Plaster of paris was chosen because of its ease of handling, ability to uniformly distribute the source throughout the material, and its density, which approximates that of common soil. (Density of soil, 1.7-2.3 g/cubic cm; density of plaster, 1.5 g/cubic cm; density of sand, 1.4 g/cubic cm)

Four different configurations of source and blank tubes were used for the calibration. Source tubes were placed three high in one of the four concentric rings of the rig for each count while the balance of the rig was filled with blanks. These configurations correspond to the source material being a radial distance of 3.75, 5.00, 6.25 and 7.50 inches from the detector.

Each configuration was counted for 900 seconds, and the area under each of the eight major Eu-152 photopeaks determined for each count.

Calculation of counts per gamma per gram was determined by the following method:

NCNTS/GAMMA/GRAM =

[NCNTS]/[(440pCi/g)(3.7E-2d/s/pCi)(900s)(ABUNDANCEgamma/d)]

For each gamma energy, the net counts/gamma/gram vs distance from the center of the detector was listed. These response curves were then plotted for each energy, for distances and activities which extend to zero net counts. This represents an "infinite" distance from the detector. Using these curves, the total counts from the detector to an infinite distance was calculated by integrating the area under the curve using Simpson's rule for approximating integrals. Of prime importance is the integral from 2 inches to infinity, since this is the area the detector will view when placed inside a 4 inch PVC casing.

Finally, the integrated net count/gamma/gram, from 2 inches to infinity, was plotted vs energy, for each of the Eu-152 photons. With this efficiency curve, a specific activity in soil (pCi/gram) can be determined from a bore hole count, assuming the radionuclide can be identified and its gamma abundance determined. The calculation is:

count, with a 95% confidence level and precision of 0.4 pCi/g.

Figure 1

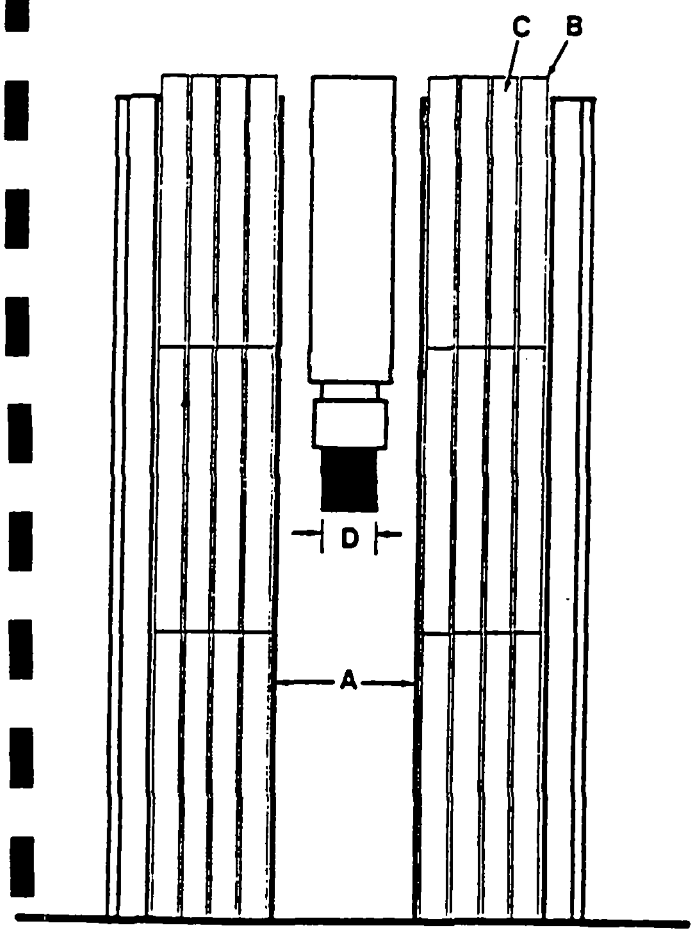
CALIBRATION RIG ASSEMBLY

"A" - 6" I.D. PVC Pipe

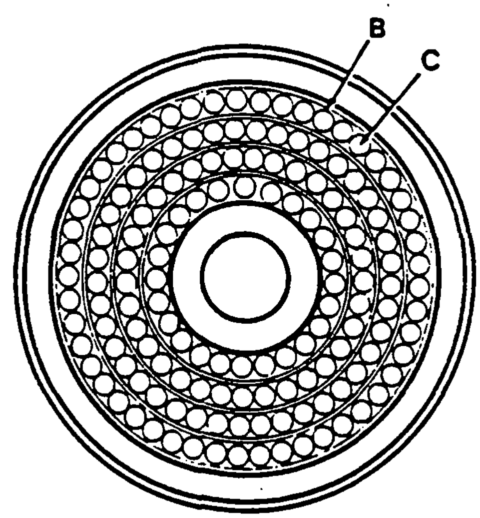
"B" - 1.25" diameter x 36" long butyrate source holder tubes

"C" - 1" diameter x 12" long source tubes. 3 per holder tube

"D" - IG Detector



Cross Section



Top View

NRC FORM 335 (11 81)

U.S. NUCLEAR REGULATORY COMMISSION

BIBLIOGRAPHIC DATA SHEET

1. REPORT NUMBER (Assigned by DDC)	NUREG/CR-2722
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7. AUTHOR(S)	L.F. Booth, D.W. Groff, G.S. McDowell, J.J. Adler, S.I. Peck, P.L. Nyerges, F.L. Bronson
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16. ABSTRACT (200 words or less)

This report presents the results of a radiological survey of the West Lake Landfill, St. Louis County, Missouri, performed by Radiation Management Corporation during the spring and summer of 1981. Measurements were made to determine external radiation levels, concentrations of airborne contaminants and the identity and concentrations of subsurface deposits. Results indicate that large volumes of uranium ore residues, probably originating from the Hazelwood, Missouri, Latty Avenue site, have been buried at the West Lake Landfill. Two areas of contamination, covering more than 15 acres and located at depths of up to 20 feet below the present surface, have been identified. There is no indication that significant quantities of contaminants are moving off-site at this time.

17. KEY WORDS AND DOCUMENT ANALYSIS

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17b. IDENTIFIERS/OPEN-ENDED TERMS

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Rev. 1

Radioactive Material in the West Lake Landfill

Summary Report

U.S. Nuclear Regulatory Commission

Office of Nuclear Material Safety and Safeguards

WEW 0009

Exhibit 14-D

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Radioactive Material in the West Lake Landfill

Summary Report

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Division of Industrial and Medical Nuclear Safety
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
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ABSTRACT

The West Lake Landfill is located near the city of St. Louis in Bridgeton, St. Louis County, Missouri. The site has been used since 1962 for disposing of municipal refuse, industrial solid and liquid wastes, and construction demolition debris.

This report summarizes the circumstances of the radioactive material in the West Lake Landfill. The radioactive material resulted from the processing of uranium ores and the subsequent sale by the AEC of processing residues. Primary emphasis is on the radiological environmental aspects as they relate to potential disposition of the material. It is concluded that remedial action is called for.

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1 INTRODUCTION AND BACKGROUND

This report summarizes the circumstances of the radioactive material in the West Lake Landfill (Figure 1), in particular, the radiological environmental aspects as they relate to potential disposition of the material.

The West Lake Landfill, Inc. property is a 200 acre tract in Bridgeton, St. Louis County, Missouri, on the outskirts of the city of St. Louis. It is about 4 miles west of St. Louis' Lambert Field International Airport, near the intersection of interstate highways I-70 and I-270. Limestone was quarried there from 1939 to 1987. Also on the property is an industrial complex where concrete ingredients are measured and combined, and where asphalt aggregate is prepared. Since 1962, portions of the property have been used as landfills for disposing of municipal refuse, industrial solid and liquid wastes, and construction demolition debris. In 1973, soil contaminated with radioactive material was placed in a landfill there.

The radioactive material originated with uranium-ore-processing residues which had been stored at Lambert Airport by the U.S. Atomic Energy Commission (AEC), and which were sold in early 1966 to the Continental Mining and Milling Company, of Chicago, Illinois. The AEC's invitation to bid listed the following residues for purchase: 74,000 tons of Belgian Congo pitchblende raffinate containing about 113 tons of uranium; 32,500 tons of Colorado raffinate containing about 48 tons of uranium; and 8700 tons of leached barium sulfate containing about 7 tons of uranium. The material was moved from the airport during 1966 to nearby 9200 Latty Avenue, Hazelwood, Missouri. In January 1967, the Commercial Discount Corporation of Chicago took possession of the residues to remove moisture and to ship the residues to the Cotter Corporation facilities in Canon City, Colorado. In December 1969, the remaining material was sold to the Cotter Corporation. In the following four years, the residues, with the principal exception of the 8700 tons of leached barium sulfate, were shipped to Canon City.[1]

In April 1974, Region III representatives of NRC's Office of Inspection and Enforcement visited the Cotter Corporation's Latty Avenue site to check on the progress of the decommissioning activities being performed there. This inspection disclosed that in 1973 Cotter Corporation had disposed of approximately 8700 tons of leached barium sulfate residues mixed with 39,000 tons of top soil at a local landfill.[1]

By letter dated June 2, 1976, the Missouri Department of Natural Resources (MDNR) forwarded to the NRC's Region III office newspaper articles which alleged that only 9000 tons of waste had been moved from the Latty Avenue site rather than 40,000 tons and that it was moved to the West Lake Landfill rather than to the St. Louis Landfill No. 1. Region III personnel investigated the allegations and found that 43,000 tons of waste and soil had been removed from the Latty Avenue site and had been dumped at the West Lake Landfill in Bridgeton, and that the waste was covered with only about 3 feet of soil.[1]

Discussion with the West Lake Landfill operators indicated that all of the material from Latty Avenue had been disposed of in one area; however, an aerial

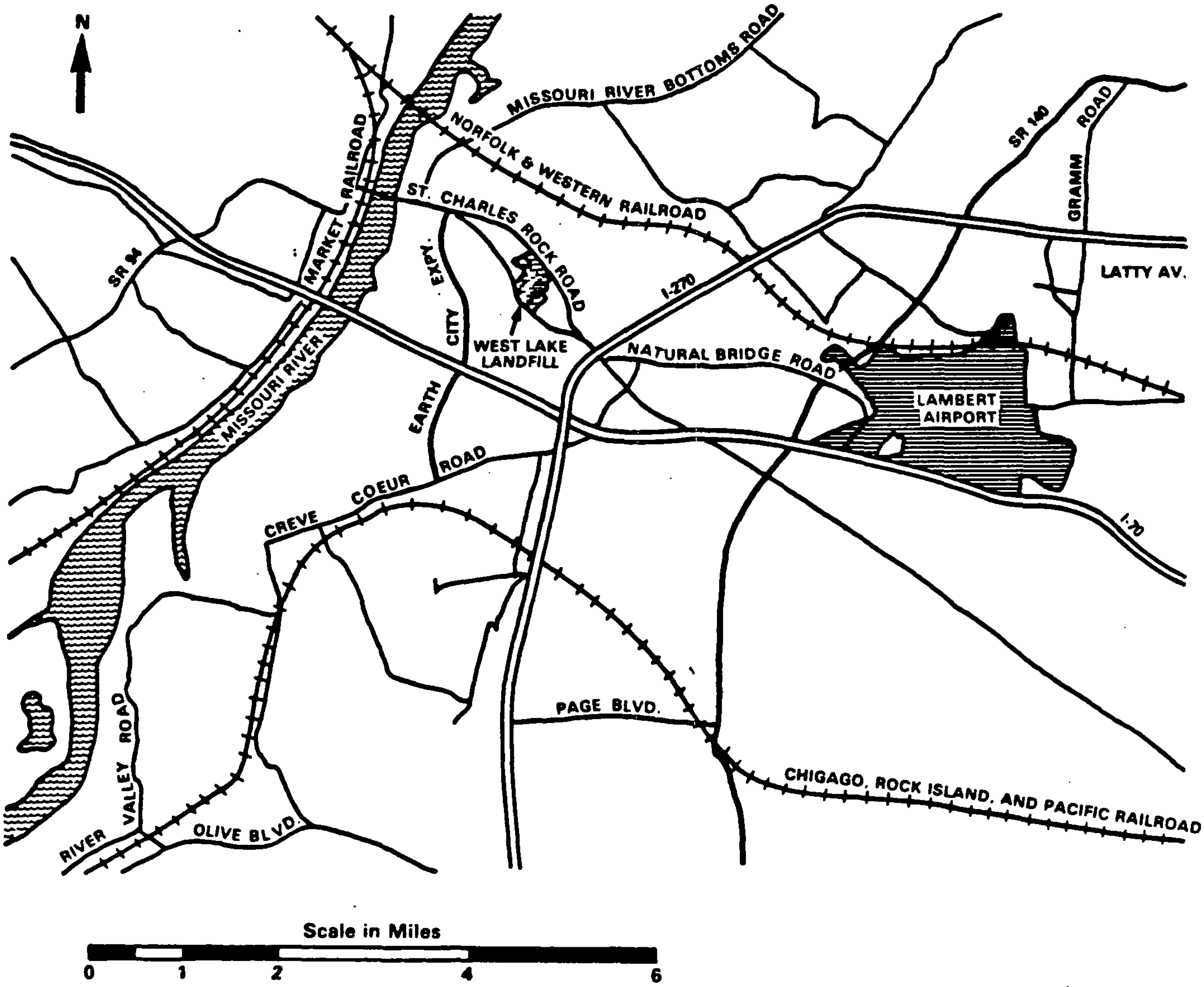

Figure 1 Location of West Lake Landfill

survey of the site identified two areas of contamination. The second contaminated area is identified as Area 1 in Figure 2.[2] Subsequently, the NRC sponsored other studies that were directed at determining the radiological status of the landfill. An extensive survey was initiated in November 1980 by the Radiation Management Corporation (RMC) under contract to the NRC. The findings were published in May 1982 in NUREG/CR-2722, "Radiological Survey of the West Lake Landfill, St. Louis County, Missouri."[3] In March 1983, the NRC through Oak Ridge Associated Universities (ORAU) contracted with the University of Missouri-Columbia (UMC), Department of Civil Engineering, to describe the environmental characteristics of the site, conduct an engineering evaluation, and propose possible remedial measures for dealing with the radioactive waste at the West Lake Landfill. In May 1986, ORAU sampled water from wells on and close to the landfill to determine if the radioactive material had migrated into the groundwater. A report is being prepared detailing the results of the investigations conducted by UMC and ORAU.[2]

Information from all these sources and from NRC site visits forms the basis for this report.

2 DESCRIPTION OF THE SITE

Location

The 200-acre West Lake Landfill site is situated on the southwest side of St. Charles Rock Road in Bridgeton, St. Louis County, Missouri (Figure 1).[2] It is about 16 miles northwest of the downtown area of the city of St. Louis, and about 4 miles west of Lambert Field International Airport (Figure 1). It is approximately 1.2 miles from the Missouri River.

History

The West Lake Landfill has been used since 1962 for the disposal of municipal refuse, industrial solid and liquid wastes, and construction demolition debris. Between 1939 and the spring of 1987, limestone was quarried there. Landfill operations filled in some of the excavated pits from the quarry operations. Also on the property is an active industrial complex in which concrete ingredients are measured and combined before mixing ("batching"), and asphalt aggregate is prepared.

The unregulated landfill, in which the radioactive material was placed in 1973, was closed in 1974 by the Missouri Department of Natural Resources (MDNR). Also in 1974, under an MDNR permit, a newer sanitary landfill was opened and now operates in an adjacent area on the West Lake Landfill property. The newer landfill is protected from groundwater contact. The bottom of the new landfill is lined with clay, and a leachate collection system has been installed. Leachate is pumped to a treatment system consisting of a lime precipitation unit followed in series by an aerated lagoon and two unaerated lagoons. The final lagoon effluent is discharged into St. Louis Metropolitan Sewer District sewers.[2]

Ownership

Since 1939, the West Lake Landfill has been owned by West Lake Landfill, Inc., of 13570 St. Charles Rock Road, Bridgeton, Missouri.

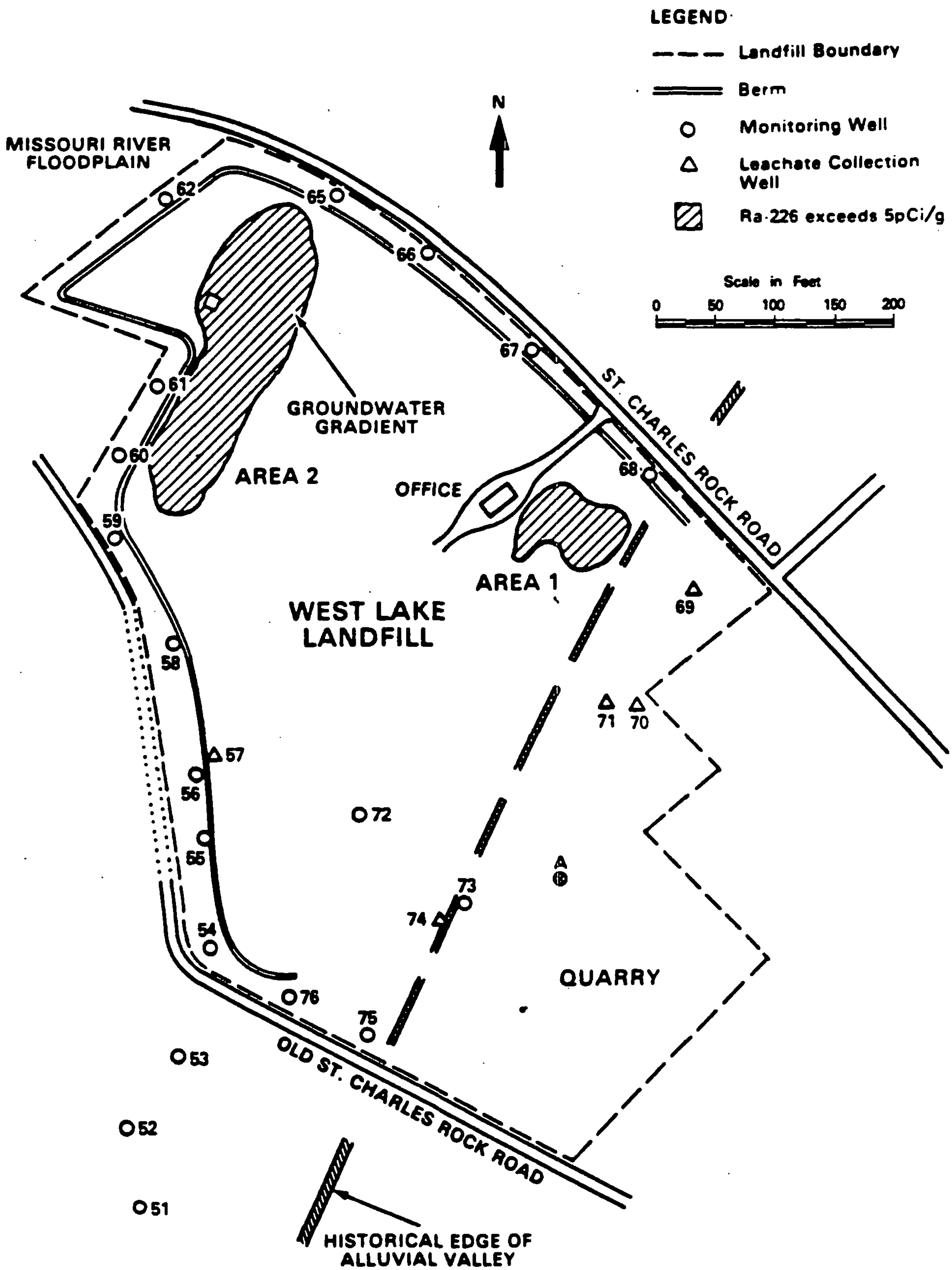

Figure 2 Site Details

Contaminated Areas

Radioactive contamination at the West Lake Landfill has been identified in two separate soil bodies (Figure 2).

The northern area (referred to as Area 2) covers about 13 acres[3] and lies above 16 to 20 feet of landfill debris. The contaminated soil forms a more or less continuous layer from 2 to 15 feet in thickness and consists of approximately 130,000 cubic yards of soil. Some of this contaminated soil is near or at the surface, particularly along the face of the northwestern berm. Beneath the landfill debris, the soil profile consists of 3 to 7 feet of floodplain top soil overlying 30 to 50 feet of sand and gravel alluvium.

The southern area of contamination (Area 1) covers about 3 acres[3] and contains roughly 20,000 cubic yards of contaminated soil. This body of soil is located east of the landfill's main office at a depth of about 3 to 5 feet and is located over a former quarry pit which was filled in with debris. The depth of debris beneath the contaminated soil is unknown but is estimated to be 50 to 65 feet. Limestone bedrock underlies the landfill debris.[2]

Topography

About 75 percent of the landfill site is located on the floodplain of the Missouri River (Figure 2) at about 440 feet above mean sea level (msl). The site topography is subject to change because of the types of activities (e.g., landfilling and quarrying) performed there. However, the areas containing the radioactive waste have their surface at about 470 feet (msl). The surface runoff in the area around the landfill follows several surface drains and ditches that run in a northwest direction and drain into the Missouri River.[2]

Geology

Bedrock beneath the West Lake Landfill consists of limestone that extends downward to an elevation of 190 feet msl. The limestone is dense, bedded, and except for intermittent layers that consist of abundant chert nodules, fairly pure. The Warsaw Formation, which lies directly beneath the limestone, is made up of approximately 40 feet of slightly calcareous, dense shale; this grades into shaley limestone toward the middle of the formation. Bedrock beneath the site dips at an angle of 0.5° to the northeast. Five miles east of the site, the attitude of the bedrock is reversed by the Florissant Dome.[2]

Since groundwater moving through carbonate rocks often creates channels for rapid water flow, the possibility of this occurring in the West Lake Landfill area was considered. Brief observation of the quarry walls at the landfill suggests that some of the limestone has dissolved. In a letter to West Lake Landfill, Inc., the Missouri Department of Natural Resources stated that the fact that grouting was necessary in the quarry area to block water inflow suggests that the limestone is at least somewhat solution weathered.[4] However, in the draft UMC report, the opinion is expressed that the solution activity has apparently been limited to minor widening of joints and bedding planes near the bedrock surface, and that, at depth and when undisturbed, the limestone is fairly impervious.[2] It is not clear whether the views represented by these statements are in conflict.

Soil material in the area may be divided into two categories: Missouri River alluvium and upland loessal soil. This demarcation is shown as the historical edge of the alluvial valley in Figure 2. The division is made on the basis of soil composition, depositional history, and physical properties. The West Lake Landfill lies over this transition zone.[2]

Hydrology

Groundwater flows in the area surrounding the West Lake site through two aquifers: the Missouri River alluvium and the shallow limestone bedrock. Although the limestone is fairly impervious and groundwater flows in most areas from the bedrock into the alluvium, contamination of water in the bedrock aquifer is possible. The base of the limestone aquifer is formed by the relatively impermeable Warsaw shale at an elevation of about 190 feet (msl). This shale layer has been reached, but not disturbed, by quarrying operations. Therefore, the Warsaw shale acts as an aquiclude, making contamination of the deeper limestone unlikely.

The deep Missouri River alluvium, which is under about 10 feet of more-recent alluvium, acts as a single aquifer of very high permeability. This aquifer is relatively homogeneous in a downstream direction and decreases in permeability near the valley walls.

The water table of the Missouri River floodplain is generally within 10 feet of the ground surface, but at many points it is even shallower. At any one time, the water levels and flow directions are influenced by both the river stage and the amount of water entering the floodplain from adjacent upland areas.

Water levels recorded between November 1983 and March 1984 in monitoring wells at the landfill, indicate a groundwater gradient of 0.005 flowing in a N 30°W direction beneath the northern portion of the landfill. This represents the likely direction of leachate migration from the landfill.

Since no other recharge sources exist above the level of the floodplain, the only water available to leach the landfill debris is that resulting from rainfall infiltrating the landfill surface. Because the underlying alluvial aquifer is highly permeable, there will be little "mounding" of water beneath the landfill. Also, the northern portion of the landfill has a level surface, and thus it is likely that at least half of the rainfall infiltrates the surface. The remaining rainfall is lost to evapotranspiration and (to a lesser degree) surface runoff.[2]

No public water supplies are drawn from the alluvial aquifer near the West Lake Landfill. It is believed that only one private well in the vicinity of the landfill is used as a drinking-water supply. This well is 1.4 miles N 35°W of the Butler-type building on the West Lake Landfill.

Because of the extremely low slope of the Missouri River floodplain surface, rain falling on the plain itself generally infiltrates the soil rather than running off the surface. The only streams present on the floodplain are those that originate in upland areas. Drainage patterns on the plain have been radically altered by flood control measures taken to protect Earth City and by drainage of swamps and marshes. Because of the relationship that exists between river level and groundwater level in portions of the floodplain near the river, streams may either lose flow (at low stage) or gain flow (at high stage).

The present channel of the Missouri River lies just under 2 miles west and northwest of the landfill. The Missouri River stage at St. Charles (mile 28) is zero for a water level of 413.7 feet (msl). Average discharge of the Missouri River is 77,338 cubic feet per second.

Water supplies are drawn from the Missouri River at mile 29 for the city of St. Charles, and the intake is located on the north bank of the river. Another intake at mile 20.5 is for the St. Louis Water Company's North County plant. The city of St. Louis takes water from the Mississippi River, which is joined by the Missouri River downstream from the landfill. The intake structures for St. Louis are on the east bank of the river, so that the water drawn is derived from the upper Mississippi.[2]

Demography

Two small residential communities are present near the West Lake Landfill: Spanish Lake Village consists of about 90 homes and is located 0.9 mile south of the landfill, and a small trailer court lies across St. Charles Rock Road, 0.9 mile southeast of the site. Subdivisions are presently being developed 1 to 2 miles east and southeast of the landfill in the hills above the floodplain. Ten or more houses lie east of the landfill, scattered along Taussig Road. The city of St. Charles is located north of the Missouri River, more than 2 miles from the landfill.[2]

Population density on the floodplain is generally less than 26 persons per square mile, but the daytime population (including factory workers) is much greater than the number of full-time residents. Earth City Industrial Park is located on the floodplain 0.9 to 1.2 miles northwest of the landfill. The Ralston-Purina facilities are located 0.2 mile northeast of the Butler-type building at the landfill. Considering that land in this area is relatively inexpensive and that much of it is zoned for manufacturing, industrial development on the floodplain will likely increase.[2]

3 RADIOLOGICAL SURVEYS

From August 1980 through the summer of 1981, the Radiation Management Corporation (RMC), under contract to the NRC, performed an onsite evaluation of the West Lake Landfill[3] to define the radiological conditions at the landfill. The results were utilized in performing this determination regarding whether or not remedial actions should be taken.

The area to be surveyed was divided into 33-foot grid blocks and included the following measurements:

(1) external gamma exposure rates 3.3 feet above the ground surface and beta-gamma count rates 0.4 inch above the surface;

(2) radionuclide concentrations in surface soils;

(3) radionuclide concentrations in subsurface deposits;

(4) total ("gross") activity and radionuclide concentrations in surface and subsurface water samples;

(5) radon flux emanating from surfaces;

(6) airborne radioactivity; and

(7) total activity in vegetation.

External Gamma

The two areas of elevated external (gamma) radiation levels, as they existed in November 1980 at the time of the preliminary RMC site survey, both contained places where levels exceeded 100 μR per hour at 3.3 feet. In Area 2, gamma levels as high as 3000 to 4000 μR per hour were detected. The total areas exceeding 20 μR per hour were about 2 acres in Area 1 and 9 acres in Area 2.[3] (The criterion of 20 μR per hour is derived from the NRC's Branch Technical Position, 46 FR 52061, October 23, 1981, which aims at exposure rates less than 10 μR per hour above background levels; background radiation was taken to be 10 μR per hour also.)

External gamma levels were measured in May and July of 1981. These levels were significantly smaller than the November 1980 values, especially in Area 1, because approximately 4 feet of sanitary fill had been added to the entire area, and an equal amount of construction fill was added to most of Area 2. As a result, only a few thousand square feet in Area 1 exceed 20 μR per hour. In Area 2, the total area exceeding 20 μR per hour decreased by about 10 percent, and the highest levels were about 1600 μR per hour near the Butler-type building.[3]

Surface Soil Analysis

A total of 61 surface soil samples were gathered and analyzed on site for gamma activity. Concentrations of U-238, Ra-226, Ra-223, Pb-211, and Pb-212 were determined for each sample. In all soil samples, only uranium and/or thorium decay chain nuclides and K-40 were detected. Offsite background samples were on the order of 2 pCi per gram for Ra-226. Onsite samples ranged from about 1 to 21,000 pCi Ra-226 per gram and from less than 10 to 2100 pCi U-238 per gram. In samples in which elevated levels of Ra-226 were detected, the concentrations of U-238 were generally one-half to one-tenth of those of Ra-226. In cases of elevated sample activity, daughter products of both U-238 and U-235 were found.[3]

In general, surface activity was limited to Area 2, as indicated by the surface beta-gamma measurements. Only two small regions in Area 1 showed surface contamination; both were near the access road across from the site offices.

In addition to onsite gamma analyses, 12 samples were submitted to RMC's radiochemical laboratories for thorium and uranium radiochemical determinations. The results of these measurements (Table 4 of NUREG/CR-2722) show that all samples contained high levels of Th-230. The ratio of Th-230 to Ra-226 (inferred from Bi-214) generally ranges from 4:1 to 40:1.

Subsurface Soil Analysis

Subsurface contamination was assessed by extensive "logging" of holes drilled through the landfill. Several holes were drilled in areas known to contain contamination, then additional holes were drilled at intervals in all directions until no further contamination was detected. A total of 43 holes were drilled (11 in Area 1 and 32 in Area 2), including 2 offsite wells for monitoring water. All holes were drilled with a 6-inch auger and were lined with 4-inch PVC (polyvinyl chloride) casing.[3]

Each hole was scanned with a 2-inch NaI(Tl) detector and rate meter system for an initial indication of the location of subsurface contamination. On the basis of the initial scans, 19 holes were selected for detailed gamma logging using the intrinsic germanium (IG) detector and multiple channel analyzer. Concentrations of Ra-226, as determined by the IG system, ranged from less than 1 pCi per gram to 22,000 pCi per gram.[3]

It was determined that the subsurface deposits extended beyond areas in which surface radiation measurements exceeded the reference level of 20 μR per hour. The lateral extent of material exceeding 5 pCi Ra-226 per gram, including both surface and buried materials, is shown on Figure 2. The total difference in areas is about 5 acres.

The surface elevations vary by about 20 feet, and the highest elevations occur at locations of more recent fill. Contaminated soil (>5 pCi Ra-226 per gram) is found from the surface to depths as great as 20 feet below the surface. In general, the contamination appears to be a continuous single layer ranging from 2 to 15 feet thick and covering 16 acres.[3]

Nonradiological Analysis

Six composite samples were submitted to RMC's Environmental Chemistry Laboratory for priority pollutant analysis. Five samples were taken from auger holes (one from Area 1 and four from Area 2) and the sixth was taken from sludge from the West Lake Landfill leachate treatment plant. The analysis shows organic solvents present in the Area 2 samples. Positive results were reported for 25 listed organic compounds. Chromium, copper, lead, nickel, and zinc were the predominant elemental priority pollutants detected. The analysis of the sample from the leachate treatment sludge showed that it had smaller pollutant concentrations than the samples from the auger holes.[3]

Chemical analyses of material from the radioactive layer from both areas were also performed by RMC's laboratory. In most cases, elevated levels of barium and lead were found.

Background Radioactivity Measurement

Several offsite locations (within a few miles of the West Lake Landfill) were selected for reference background measurements. Background values were all within the normal range. The gamma exposure rates were 8 and 10.6 μR per hour. Radium-226 concentrations in soil were 2.5 and 2.6 pCi per gram. Radon flux from the ground surface was 0.50 and 0.58 pCi per square meter-second; working level values were 0.0011, 0.0017, and 0.005 WL.[3]

Airborne Radioactivity Analysis

Both gaseous and particulate airborne radioactivity were sampled and analyzed during this study. Since it was known that the buried material consisted partially or totally of uranium ore residues, the sampling program concentrated on measuring radon and its daughters in the air. Two methods were used: the first was a scintillation flask (accumulator) method for radon gas, and the second was analysis of filter paper activity for particulate daughters. A series of grab samples using the accumulator method were taken between May and August of 1981. A total of 111 samples from 32 locations were collected. Measurable radon flux levels ranged from 0.2 pCi per square meter-second in low background areas to 865 pCi per square meter-second in areas of surface contamination.[3]

At three locations, measurements were repeated over a period of 2 months. Significant fluctuations were observed at two locations. The fact that these fluctuations were real and not measurement artifacts was later confirmed by duplicate charcoal canister samples.

A set of 10-minute, high-volume, particulate, air samples was taken to determine both short-lived radon daughter concentrations and long-lived gross alpha activity. The highest levels (0.031 WL) were detected in November 1980, near and inside the Butler-type building. These two samples approximately equal NRC's 10 CFR Part 20, Appendix B, alternate concentration limit of one-thirtieth WL for unrestricted areas. In addition to the routine 10-minute samples, five 20-minute, high-volume, air samples were taken and counted immediately on the IG gamma spectroscopy system to detect the presence of Rn-219 daughters. All samples were taken near surface contamination. Concentrations of Rn-219 daughters ranged from 6×10^{-11} to 9×10^{-10} μCi per cubic centimeter.[3]

Vegetation Analysis

Vegetation samples collected by RMC included weed samples from onsite locations and farm crop samples (winter wheat) near the northwest boundary of the landfill. This location was chosen because water could run off from the fill onto the farm field. No elevated activities were found in these samples.[3]

Water Analysis

A total of 37 water samples were taken by RMC and analyzed for gross alpha and beta activity. Four samples were taken in the fall of 1980 and the remainder in the spring and summer of 1981. One sample was equal to the U.S. Environmental Protection Agency (EPA) gross-alpha-activity standard for drinking water of 15 pCi per liter and that was a sample of standing water near the Butler-type building. Several samples, including all the leachate treatment plant samples, exceeded the EPA drinking water action level for gross beta activity. Subsequent isotopic analyses indicated that the beta activity could be attributed to K-40. None of the offsite samples exceeded either EPA standard.[3]

In 1981, the Missouri Department of Natural Resources collected 41 water samples that RMC analyzed for radioactivity. Of these samples, 5 were background, 10 were onsite surface water, 10 were shallow groundwater standing in boreholes, and 16 were landfill leachate. From these data, background activity is estimated as 1.5 pCi gross alpha activity per liter and 30 pCi gross beta activity per liter. One groundwater sample was at 15 pCi gross alpha per liter, and one surface water sample was 45 pCi per liter. Most of the leachate samples were above 50 pCi beta per liter.[3]

In addition, groundwater samples in 11 perimeter monitoring wells at the West Lake Landfill were taken by the Reitz and Jens Engineering firm on November 15, 1983, and by University of Missouri at Columbia (UMC) personnel on March 21, 1984. In both sampling times, one well, but not the same one, exceeded the EPA's drinking water standard of 15 pCi per liter (18.2 pCi per liter in 1983 and 20.5 pCi per liter in 1984). On May 7 and 8, 1986, Oak Ridge Associated Universities (ORAU) personnel took water samples from 44 perimeter wells; only one (by Old St. Charles Rock Road) with 17 pCi alpha activity per liter exceeded the drinking water standard.[2]

The operators of the landfill, West Lake Landfill, Inc., have an ongoing hydrogeologic investigation of the site, which also involves analyses of monitoring well samples for radioactivity and for priority pollutants.[4]

4 ESTIMATION OF RADIOACTIVITY INVENTORY

Soil sample analyses have shown that the radioactive material in Areas 1 and 2 of the landfill consists almost entirely of natural uranium and its radioactive decay products.

The analyses of soil samples indicate that the naturally occurring U-238 to Th-230 to Ra-226 equilibrium has been altered and that the ratio of Ra-226 to U-238 is on the order of 2:1 to 10:1; the ratio of Th-230 to Ra-226 generally ranges from 4:1 to about 40:1. These ratios are in accord with the history of the radionuclide deposits in the West Lake Landfill, i.e., that they came from the processing of uranium ores. The indicator radionuclides for assessment of the radiological impacts of the material are therefore U-238, Th-230, and Ra-226.

Using the RMC data and averaging the auger hole measurements over the volumes of radioactive material found in Areas 1 and 2, a mean concentration of 90 pCi per gram was calculated for Ra-226.[2] For the ratio of Th-230 to Ra-226, the RMC data[3] range from 4:1 to 40:1; data from samples taken in 1984 along the berm range up to almost 70:1.[5] A further consideration is that the material came from Cotter Corporation's Latty Avenue site (later sold to Futura Coatings, Inc.). Measurements at the Latty Avenue site are variously reported as up to 180:1[6] and about 300:1.[7] Some material of that nature might have been transferred along with the barium sulfate residues. To ensure conservatism in estimating the long-term in-growth of Ra-226, the NRC staff used a ratio of 100:1 to estimate the Th-230 activity. Similarly, the Ra-226:U-238 ratio ranges from 2:1 to 10:1. This ratio is less critical to the radiological aspect of the site and has been estimated to be 5:1 for purposes of calculation.

Using the Th-230:Ra-226 ratio of 100:1, the Th-230 activity is 9000 pCi per gram. If the U-238 concentration (as well as U-234 which would be similarly separated from the ore) is a factor of 5 less than Ra-226, this implies about 18 pCi U-238 per gram. The total mass of radioactive material in the landfill was estimated by visually integrating the volume of radioactive material from graphs and multiplying by an average soil density, resulting in 1.5×10^{11} grams (150,000 metric tons) of contaminated soil.

These numbers indicate that there are about 14 Ci of Ra-226 contained with its decay products in the radioactive material in the landfill. The material also contains about 3 Ci each of U-238 and U-234, and about 1400 Ci of Th-230. These estimates indicate the order of magnitude of the quantities to be dealt with, although the estimate for Th-230 is regarded as conservatively large.

5 APPLICABILITY OF THE BRANCH TECHNICAL POSITION

The NRC has established a Branch Technical Position (BTP) which identifies five acceptable options for disposal or onsite storage of wastes containing low levels of uranium and thorium (46 FR 52061, October 23, 1981).[8]

The concentrations permitted under each disposal option are shown in Table 1.

Table 1 Summary of maximum soil concentrations permitted under disposal options

Source: 46 Federal Register 52061

	Disposal options			
Kind of material	1[a]	2[b]	3[c]	4[d]
Natural thorium (Th-232 + Th-228) with daughters present and in equilibrium. (pCi/g)	10	50	-	500
Natural uranium (U-238 + U-234) with daughters present and in equilibrium. (pCi/g)	10	-	40	200

[a]Based on EPA uranium mill tailings cleanup standards.

[b]Concentrations based on limiting individual doses to 170 mrem per year.

[c]Concentration based on limiting equivalent exposure to 0.02 WL or less.

[d]Concentrations based on limiting individual intruder doses to 500 mrem per year and, in cases of natural uranium, limiting exposure to Rn-222 and other airborne alpha emitters to 0.02 WL or less.

Options 1-4 provide methods under 10 CFR 20.302, for onsite disposal of slightly contaminated materials, e.g., soil, if the concentrations of radioactivity are small enough and other circumstances are satisfactory. The fifth option consists of onsite storage pending availability of an appropriate disposal method.

The material present in the West Lake Landfill is a form of natural uranium with daughters, although the daughters are not now in equilibrium. As mentioned in

Section 4, the average concentration of Ra-226 in the West Lake Landfill wastes is about 90 pCi per gram, which (considered by itself) falls into Option 4 of the BTP since Option 4 criteria are controlled by the Ra-226 content in the wastes (i.e., 200 pCi of U-238 plus U-234 per gram would be accompanied by 100 pCi of Ra-226 per gram). However, because of the large ratio of Th-230 radioactivity to that of Ra-226, the radioactive decay of the Th-230 will increase the concentration of its decay product Ra-226 until these two radionuclides are again in equilibrium. Assuming the ratio of activities of 100:1 used above, the Ra-226 activity will increase by a factor of five over the next 100 years, by a factor of nine 200 years from now, and by a factor of thirty-five 1000 years from now. All radionuclides in the decay chain after Ra-226 (and thus the Rn-222 gas flux) will also be increased by similar multiples. Therefore, the long-term Ra-226 concentration will exceed the Option 4 criteria. Under these conditions, onsite disposal, if possible, will likely require moving the material to a carefully designed and constructed "disposal cell."

6 REMEDIAL ACTION ALTERNATIVES EXAMINED

The evaluation performed by staff of the University of Missouri at Columbia addresses six potential remedial action alternatives, including that of leaving the radioactive material as it is, designated Option A.[2] Option D is the option of excavating the material and shipping it to another site for disposal. Options B, C, E, and F address different approaches to stabilizing the material on the West Lake Landfill site, primarily as temporary remedial actions. Options B, C, and F leave most of the radioactive material where it is but include a variety of measures to contain it and its radon releases and gamma emissions. Option E addresses the approach of constructing an onsite earthen cell, similar to a disposal cell, and moving the radioactive material into it. Under Option F, the radioactive material would be left in place and separate slurry walls would be built downgradient of Areas 1 and 2 to constrain groundwater motion. The estimated costs of Options B through F range from about $370,000 (Option B) to about $5,500,000 (Option F) in 1984 dollars. The estimate for Option D is about $2,500,000, but this does not include the cost of transporting the material to another site and disposing of it there; in the staff's judgment, this could increase the cost by as much as a factor of ten.

Further studies are necessary to determine the most practical approach to disposal of this material.

7 FACTORS CONTRIBUTING UNCERTAINTY

The presence in the landfill of other substances listed as hazardous by the U.S. Environmental Protection Agency raises issues of whether the waste is mixed waste (i.e., both radioactive and chemically hazardous), and whether the landfill must also be disturbed to provide for proper containment of the chemical wastes.

The manner of placing the 43,000 tons of contaminated soil in the landfill caused it to be mixed with additional soil and other material, so that now an appreciably larger amount is involved. If it must be moved, it is not certain whether the amount requiring disposal elsewhere is as little as 60,000 tons or even more than 150,000 tons.

Because the controlling radionuclide (Th-230) has no characteristics that make it easy to measure quantitatively in place, as can be done for the Ra-226 with its decay products, the large but variable ratio of Th-230 to Ra-226 and its decay products makes the delineation of cleanup more difficult. When the ratio is so large (20:1 or more), even a small concentration of Ra-226 in 1988 implies such a large concentration later that it will be necessary to employ more difficult measurement techniques to confirm that the cleanup has been satisfactory.

Any possibility of disposal on site will depend on adequate isolation of the waste from the environment, especially for protection of the groundwater. It is unclear whether the area's groundwater can be protected from onsite disposal at a reasonable cost. This matter will require additional investigation.

8 SUMMARY

In 1973, radioactively contaminated soil amounting to approximately 43,000 tons was deposited in the West Lake Landfill near St. Louis, Missouri. The material originated with decontamination efforts at the Cotter Corporation's Latty Avenue plant. Disposal in the West Lake Landfill was not authorized by the NRC. State officials were not notified of this disposal in 1973 because the landfill was not regulated by the State at the time.

In the period 1980-1981, Radiation Management Corporation (RMC) of Chicago, Illinois, under contract to the NRC, performed a detailed radiological survey of the West Lake Landfill. This survey showed that the radioactive contaminants are in two areas. The northern area (Area 2) covers about 13 acres. The radioactive debris forms a layer 2 to 15 feet thick, exposed in only a small area on the landfill surface and along the berm on the northwest face of the landfill. The southern area (Area 1) contains a relatively minor fraction of the debris covering approximately 3 acres with most of the contaminated soil buried with about 3 feet of clean soil and sanitary fill.

The RMC survey showed that the radioactivity is from the naturally occurring U-238 and U-235 series with Th-230 and Ra-226 as the radionuclides that dominate radiological impact. The survey data indicate that the average Ra-226 concentration in the radioactive wastes is about 90 pCi per gram; the staff estimates the average Th-230 concentration to be about 9000 pCi per gram. Since Ra-226 has been depleted with respect to its parent Th-230, Ra-226 activity will increase in time (for example, over the next 200 years, Ra-226 activity will increase ninefold over the present level). This increase in Ra-226 must be considered in evaluating the long-term hazard posed by this radioactive material.

In addition to RMC's radiological survey, soil and water samples were collected and analyzed by others, including ORAU, UMC, and MDNR. Occasionally a sample of water from a monitoring well exceeds slightly the EPA drinking water standard of 15 pCi gross alpha per liter. Sample analyses for priority pollutants (nonradioactive hazardous substances) show a number of listed pollutants are present. The landfill operators are also conducting a hydrogeological investigation.

From the RMC, UMC, and ORAU surveys conducted at the West Lake Landfill site the staff has made the following findings:

(1) There is a large quantity (on the order of 150,000 tons) of soil contaminated with long-lived radioactive material in the West Lake Landfill. Almost all the radioactivity consists of natural uranium and its radioactive decay products.[3]

(2) Based on the radiological surveys, the radioactive wastes as presently stored at the West Lake Landfill do not satisfy the conditions for Options 1-4 of the NRC's Branch Technical Position (BTP) regarding the disposal of radioactive wastes containing uranium or thorium residues.[8]

(3) A dominant factor for the future is that the average activity concentration of Th-230 is much larger than that of its decay product Ra-226, indicating a significant increase in the radiological hazards in the years and centuries to come.

(4) Some of the radioactive material on the northwestern face of the berm has no protective cover of soil to prevent the spread of contamination and attenuate radiation.

(5) Slightly more than 8 acres of the site exceed 20 μR per hour; the highest reading of 1600 μR per hour occurs near the Butler-type building.

(6) Radon and daughters were measured at 0.031 WL in and around the Butler-type building. This exceeds the BTP value of 0.02 WL.

(7) Based on monitoring-well sample analyses, some low-level contamination of the groundwater is occurring, indicating that the groundwater in the vicinity is not adequately protected by the present disposition of the wastes.

(8) Although these radiological conditions indicate that remedial action is needed, it is unlikely that anyone has received significant radiation exposures from the existing situation.

(9) Sampling results show that chemically hazardous materials have been disposed of adjacent to or possibly mixed with the radioactive material.[3] It is possible that part of the radioactive material has become "mixed" waste.

From these findings and the information developed to date, the NRC staff concludes: (1) measures must be taken to establish adequate permanent control of the radioactive waste and to mitigate the potential long-term adverse impacts from its existing temporary storage conditions and (2) the information developed to date is inadequate for a technological determination of several important issues, i.e., whether mixed wastes are involved, and whether onsite disposal is practical technologically, and, if so, under what alternative methods.

As indicated by the estimates developed by UMC, remedial action will be costly. Further, the investigations to develop the necessary information to resolve major questions and to provide a sound basis for evaluation of the feasibility of disposal alternatives may also be costly. Therefore, it is necessary to determine the way to accomplish the further studies and remedial actions that are needed.

9 REFERENCES

[1]U.S. Nuclear Regulatory Commission, Office of Inspection and Enforcement, Region III, "IE Investigation Report No. 76-01," January 4, 1977.

[2]S.K. Banerji, W.H. Miller, J.T. O'Connor, L.S. Uhazy, "Site Characterization and Remedial Action Concepts for the West Lake Landfill," University of Missouri-Columbia, Columbia, Missouri 65211 (in preparation).

[3]Radiation Management Corporation, "Radiological Survey of the West Lake Landfill, St. Louis County, Missouri," NUREG/CR-2722, U.S. Nuclear Regulatory Commission, May 1982.

[4]N.A. DiPasquale, Missouri Department of Natural Resources, letter dated October 9, 1987, to W. E. Whitaker, President, West Lake Landfill, Inc., re: Hydrogeologic Investigation, West Lake Landfill, Primary Phase Report, Received November 4, 1986.

[5]A.J. Boerner, "Survey for Berm Erosion, West Lake Landfill, St. Louis County, Missouri," Oak Ridge Associated Universities, April 6, 1984.

[6]L.W. Cole, "Radiological Evaluation of Decontamination Debris Located at the Futura Coatings Company Facility," Oak Ridge Associated Universities, September 1981.

[7]L.W. Cole, "Preliminary Radiological Survey of Proposed Street Right-of-Way at Futura Coatings, Inc., 9200 Latty Avenue, Hazelwood, Missouri," Oak Ridge Associated Universities, December 1981.

[8]U.S. Nuclear Regulatory Commission, Uranium Fuel Licensing Branch, Branch Technical Position, "Disposal or Onsite Storage of Thorium or Uranium Waste From Past Operations," Federal Register, Vol. 46, pages 52061-52063, October 23, 1981.

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13. ABSTRACT (200 words or less)

The West Lake Landfill is located near the city of St. Louis in Bridgeton, St. Louis County, Missouri. The site has been used since 1962 for disposing of municipal refuse, industrial solid and liquid wastes, and construction demolition debris. This report summarizes the circumstances of the radioactive material in the West Lake Landfill. The radioactive material resulted from the processing of uranium ores and the subsequent sale by the Atomic Energy Commission of the processing residues. Primary emphasis is on the radiological environmental aspects as they relate to potential disposition of the material. It is concluded that remedial action is called for.

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